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ABSTRACT

Although the major factors determining curriculum mix are known, little has been done to measure the relative importance of each factor. Using the data gathered by questionnaire from North Carolina community colleges and technical institutes, this study tested the hypotheses that local labor market structures influence curricular offerings, and that budgetary allocation procedures within the educational system create internal monetary incentives which affect curricular offerings. Least squares regression analysis indicated that curricular offerings were positively related to absolute size of the "using" industry but negatively related to its relative size. Data received from the North Carolina Department of Community Colleges confirmed the second hypothesis, that curriculum mix is affected by the local administrators' budgetary allocations. This can result in a drift in curriculum away from optimality toward a position more "profitable" to the local administrator in terms of budgetary considerations. (BH)

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# LABOR MARKETS, INCENTIVES AND OCCUPATIONAL EDUCATION

**ROBERT M. FEARN**
DEPARTMENT OF ECONOMICS
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## Center Research Monograph No. 3

CENTER FOR OCCUPATIONAL EDUCATION
NORTH CAROLINA STATE UNIVERSITY AT RALEIGH
1969

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF EDUCATION—BUREAU OF RESEARCH
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Center Research Monograph No. 3

CENTER FOR OCCUPATIONAL EDUCATION

North Carolina State University at Raleigh

Raleigh, North Carolina

1969

# PREFACE

One of the basic ideas upon which the Center for Occupational Education was founded, and upon which it has continued to operate since its inception, was the idea that contributions to the field of occupational education could be made by a wide variety of disciplines. The experience of the Center over the years has justified its faith in the multidisciplinary approach to the solution of educational problems. The research reported in this monograph represents a contribution by an economist to a problem which might never have been undertaken by a researcher trained solely in the field of education. In its methods and its findings it opens up a whole new field of interest for occupational researchers.

Primarily, Dr. Fearn has been interested in an investigation of the possible influences of local labor market conditions on curricular offerings at locally administered community colleges and technical institutes. In addition to this, he has developed some information on a problem of particular interest to occupational educators, that of the possible influence of incentives internal to the educational system on curriculum development. His attention to a variety of research techniques should be of great interest to other economists who might be turning their attention toward research in similar areas of education.

The Center is indebted to Dr. Robert M. Fearn who completed the study and to the following members of the panel who reviewed the report:

Dr. Charles H. Rogers, Associate Professor of Agricultural Education
Dr. Charles V. Mercer, Associate Professor of Sociology and Anthropology
Dr. Loren A. Ihnen, Associate Professor of Economics

all of North Carolina State University at Raleigh.

The Center also extends its appreciation to Miss Reggi Jackson who assisted in the preparation and typing of the manuscript and Mrs. Sue Mills who arranged for its reproduction. The technical and editorial assistance of the Center staff is also gratefully acknowledged.

John K. Coster
Director

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# Forces Influencing Curriculum Mix

Educational literature and several theories from the social sciences suggest a set of forces expected to influence curriculum mix at public post-secondary institutions. These include:

1. Demand by students or prospective students for particular curricula,
2. Demand by local businesses or industries,
3. Plans promulgated by superior political or educational administrative offices (e.g.; the State Planning Commission, the State Board of Education, the Department of Community Colleges, etc.),
4. Financial support and demands by local political authorities (e.g.; the town or county commissioners, the City Council, etc.),
5. Internal incentives implicit in the budgetary and accounting procedures of the "system",
6. Fixed costs of the institution and separable costs for each curriculum, and
7. Tastes and preferences of administrators of individual institutions with regard to the "benefits" of particular educational programs.

Although this list is not exhaustive, it does contain what appear to be the major forces involved in the determination of the curriculum mix. The list does not imply any hierarchy of influences for our knowledge of the relative effects of each force is limited. Moreover, neither the interaction of the forces with each other nor the mechanisms by which the various forces influence the mix of curriculum is completely clear at this juncture.

# CHAPTER I

# INTRODUCTION

One of the primary problems faced by educational planners and by others charged with providing or evaluating educational services is the determination of an appropriate mix of curricular offerings. The problem is of particular importance in the growing number of publicly supported community colleges and technical institutes throughout the country.

Although the major forces which shape the mix of curricula are recognized in the literature,[1] we have only a limited understanding of the relative impact of each of these forces within an educational institution, within an educational system, and between educational systems. Concern has been expressed in many places, but the empirical research results have been meager.

The objective of this study is a limited one. It is intended to elaborate two parts of a much broader supply and demand model of curricular offerings at community colleges and technical institutes. The complete model contains a number of serious analytical problems and thus cannot be completely specified at this time. It is possible, however, to proceed profitably in two areas of analysis. Indeed, the paucity of research and data in this area dictates such a limited approach at this time. Hopefully, experimentation and probing on a portion of the overall model will point the way toward a more general approach.

---

[1] M. Blaug, "An Economic Interpretation of the Private Demand for Education", Economica (New Series), Vol. XXXIII (1966), pp. 166-182: Robert Campbell and B. N. Siegel, "Demand for Higher Education in the United States", American Economic Review, Vol. LXII (1967), pp. 482-494; and Guy H. Orcutt, Martin Greenberger, John Korbel, and Alice Rivlin, Microanalysis of Socioeconomic Systems: A Simulation Study, (New York: Harper and Row, 1961).

This study concentrates on items 2, 5, and 6 in the list above. The influence of business and industrial demand on curriculum mix is examined in Chapter 2. The relevant theoretical model is derived from economic theory, the statistical procedure is ordinary least squares regression analysis, and the data base is the system of community colleges and technical institutes in North Carolina from 1963 to the present. Although the regressions are run solely with North Carolina data, the analytical approach and the results of the analysis are believed to be applicable throughout the nation. In Chapter 3, an alternative analytical approach--probit analysis--is examined and the promise of that approach for future research is explored. Chapter 4 elaborates a model for isolating the influence of internal incentives and cost structures upon curriculum mix within and between industries. The model implies that a "curriculum drift" of some sort is endemic to community college systems. North Carolina data are examined to ascertain whether the "drift" was in the direction suggested by theory; given the expected separable cost levels of the various curricula and given the budgetary and accounting procedures of the system. The chapter ends with a brief consideration of the use of the analysis by central planners and the data requirements for the control system implied by the analysis.

# CHAPTER II

# OCCUPATIONAL EDUCATION AND MONOPSONY POWER

Economic theory suggests that there may be a discernible relationship between the location of occupational training and the labor market power of local employers. This implication emerges from a consideration of the conventional theory of monopsony in the labor market. More "realistically," the implication depends upon the existence of a labor market monopsony cartel--either implicit or explicit.

## Theoretical Structure

The work of Gary Becker,[1] Jacob Mincer,[2] and Melvin Reder[3] suggests that labor market monopsonists will be more likely to conduct employer-financed training programs (either OJT or external) for their employees than will competitive firms. Alternatively stated, whenever labor can move freely among various employers within the same labor market (at low transfer costs), competition in the labor market will equate wages with the value of the marginal contribution of labor to production (VMP); allowing no leeway for recovery of the previous training costs borne by employers.

The Becker-Mincer argument concerning the inability or limited ability of competitive firms in the labor market to recover the costs of training is, of course, analogous to the inability or limited ability of competitive firms in the product market to capture the gains from own-financed research; a point stressed, in particular, in the literature of agricultural economics.

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[1] Gary S. Becker, Human Capital (New York: Columbia University Press, 1964), pp. 1-159.

[2] Jacob Mincer, "On-the-Job Training: Costs, Returns, and Some Implications," Journal of Political Economy, Vol. LXX, No. 5, Part 2, October, 1962, pp. 50-79.

[3] M. V. Reder, "Gary Becker's Human Capital, A Review Article," Journal of Human Resources, Vol. II, No. 1 (1967), pp. 97-104.

Melvin Reder's classic article provided an additional new insight into the economics of company financed training. He correctly argued that the monopsony relationship may be substantially altered after the employer-financed training is completed in that the trained employee could impose a capital loss on the company by withdrawing his services. This power is analogous to the power of the monopsonist who has control over the wage rate and employment opportunities. Thus, we have a bilateral monopoly situation after training (a monopsonist facing a monopolist) in which the final distribution of benefits (and the employer's ability to recover his costs) depends upon bargaining between the parties. From a theoretical standpoint, the resulting wage is indeterminant. The division of the increased VMP provided by training presumably will be based upon tactics or bargaining skill, the worker's preference for remaining with the company, bureaucratic scriptures, and the like.

Without overlooking the bilateral monopoly aspects of the *ex post* training situation emphasized by Reder, the theoretical structure leaves one with the presumption that competitive firms will more actively seek alternatives to employer-financed training programs than will monopsonists or monopsony cartelists.

As noted by Becker, Mincer, and Reder, a considerable amount of casual empirical evidence supports this thesis. For example, training which is highly specific to the operations of the particular firm (orientation *et.al.*) is provided quite generally throughout industry. Such training "fits" the monopsony argument for it adds little or nothing to the market value of the workers while raising their internal VMP's. Where skills are widely and easily transferable among employers, collective or socialized training methods are often employed. Examples include the various Schools of Engineering around the country, the U.S. Air Force training ground for commercial airline pilots, and union apprenticeship programs in the construction industry. Additional evidence is found in the literature of industrial relations which contains many references to imperfections in the labor market. One of those most frequently mentioned is the "anti-pirating agreement."[4] Such agreements--overt or tacit--limit labor market hiring of new personnel to persons not presently employed by parties to the agreement. The monopsony theory suggests that "anti-pirating agreements" may have their rationale in the attempt by personnel managers to approximate monopsony conditions within a competitive labor market so that beneficial training could be undertaken and/or continued. If this is the rationale behind such agreements, we would expect personnel managers to become much more disturbed about "pirating" of skilled (or trained) workers than of unskilled workers. Casual empiricism strongly suggests that anti-pirating agreements really do not apply to the lower skill categories.

This research goes beyond the crude "tests" provided by casual empiricism: employing data from the post-secondary technical and vocational training programs in North Carolina and the response of these programs to differences in labor market conditions. Before considering the

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[4] See in particular, Lloyd Reynolds, The Structure of Labor Markets (New York, Harper and Brothers, 1951), pp. 51-52 and 271.

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empirical results, a few comments on the incidence of monopsony are in order, and the formal model needs to be made more explicit.

## Incidence of Labor Market Monopsony

Robert L. Bunting's classic work, Employer Concentration in Local Labor Markets,[5] provides convincing evidence that American labor markets are not generally characterized by monopsony. Bunting's work, however, did not subdivide the labor force into occupations or skills. Although little monopsony can be found when one considers labor as a single commodity, as Bunting did, the degree of monopsony for a particular skilled occupation may be substantial. This monograph views monopsony as specific to a particular skill category; namely that category of skills imparted by a particular curriculum. These skills are viewed as specific to particular industry subsectors. Following Becker, Mincer, and Reder, it is just such differences in monopsony which may influence the financing (and perhaps the physical location) of skill acquisition.

## A Southern Scenario

The discussion above appears to be relevant to the present-day South. If the financing of training programs is sensitive to the labor market structure, then the growing industrialization of the South may represent a movement toward or away from monopsony within particular labor market areas and skill categories. The direction of the movement will depend, of course, upon the size and number of the new (or expanded) industrial units--relative to the employment mix among existing firms. One possible scenario is the following:

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[5] Robert L. Bunting, Employer Concentration in Local Labor Markets (Chapel Hill, N. C.: The University of North Carolina Press, 1962).

> As new firms establish themselves in a community, relative earnings of skilled workers rise in the occupations required by the new firms - reflecting supply inelasticities and perhaps the higher productivity of the new, more capital intensive firms. Firms with some degree of monopsony power will finance the training of their own employees. As the labor market continues to be elaborated with the addition of new firms, employers may institute a series of moves to keep turnover rates low (protect the returns to previous and future investments in their employees) and/or to shift the costs of training to the employees or the public. Among the techniques which might be employed are (1) the establishment of anti-pirating agreements among major employers, (2) a general tightening of in-plant training toward greater company specificity, (3) the establishment of formal apprenticeship systems with wider differentials between the earnings of apprentices and journeymen, and (4) an attempt to have training in these areas conducted externally in community colleges, technical institutes, or whatever.[6]

Because North Carolina and a number of other Southern States have encouraged industry to make use of their systems of locally-operated community colleges and technical institutes, one might expect to observe some part of the monopsony effects by observing the incidence and institution of new curricula among the various institutions in response to differences and changes in labor market structures.

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[6] Alternatively, where the number of firms using particular skills is few, each firm may continue its training program with no limitations on cross hiring. This may exist, in particular, where the pattern of employment is erratic--as in the case of electronic or aircraft components prepared under short term or adjustable government contracts. Note, however, that even in this case incentives exist for each firm to dodge their cartel responsibilities and rely on others for their trained workers.

## A North Carolina Test - Data and Data Concerns

At the beginning of the 1967-68 academic year, 44 operating community colleges and technical institutes in North Carolina offered programs in 51 technical fields and 41 vocational areas. Among the 51 technical fields (two year programs) were fields such as agricultural business, food processing, ornamental horticulture, drafting, police science, and dental hygiene. Vocational curricula (generally one year programs) stretched across an equally wide range including, for example, auto mechanics, carpentry, farriering, heavy equipment operations, marine mechanics, psychiatric aides, masonry, and practical nursing.[7] Using the curricular descriptions contained in the Counselor's Guide,[8] some of the curricula can be matched with the industrial sectors in which the imparted skills can subsequently be employed. The sectors can be identified by their two, three or four digit Standard Industrial Classification numbers. Matching was not useful in many cases. For example, the market for secretaries in any local area encompasses most if not all SIC categories. Following the logic of the Becker-Mincer-Reder hypothesis, it's not surprising to find secretarial training offered at almost all the 44 institutions. Similar comments are appropriate for business administration.[9] Similarly, it is likely that there are numerous employers of auto mechanics, practical nurses, and welders in any local area, and these programs also are offered widely.

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[7] These curricular offerings are shown in Table 1.

[8] North Carolina Department of Community Colleges, Counselor's Guide (Raleigh, N. C. Unnumbered Pamphlet, Department of Community Colleges, January, 1968).

[9] Another explanation for the widespread instruction in secretarial skills and business administration is considered in Chapter IV.

## TABLE 1
## Curricular Offerings at N. C. Community Colleges and Technical Institutes, 1967-68 [a]

| COLLEGE PARALLEL PROGRAMS 1966-67 | LIBERAL ARTS | PRE-PROFESSIONAL | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Agriculture | Art | Architecture | Business Adm. | Business Ed. | Dental | Drama | Engineering | Forestry | Journalism | Law | Mathematics | Medical | Ministerial | Music | Nursing | Optometry | Pharmacy | Physical Therapy | Public Adm. | Science** | Social Work | Teaching Elem. | Teaching Sec. | Vet. Medicine |
| COMMUNITY COLLEGES | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Central Piedmont | X | X | | | | X | X | | X | X | X | X | | X | | | | | X | | X | | X | X | X | |
| College of the Albemarle | X | | | | X | X | | | | | | | | | | | | | | | | | | | | |
| Davidson County | X | | | | X | | | | X | | | | X | | | | | | | | | X | | X | X | |
| Gaston College | X | X | X | | X | | X | | X | X | X | X | X | X | X | X | | X | X | | | X | X | X | X | |
| Isothermal | X | | | | X | | | X | X | | | X | X | X | | X | | | | | | | X | X | X | |
| Lenoir County | X | X | | | X | X | X | | X | | | X | X | X | X | | | X | X | X | | X | X | X | X | |
| Rockingham | X | X | X | | X | | X | | X | X | | X | X | X | X | X | | | | | | X | X | X | X | |
| Sandhills | X | | | X | X | | X | | X | X | | X | X | X | X | X | | | X | | | X | X | X | X | X |
| Southeastern | X | | | | X | | | | X | | | | | | | | | | | | | X | | X | X | |
| Surry | X | | | | X | | | | X | | | | | | | | | | | | | | | | | |
| Western Piedmont | X | | X | | X | | | | X | X | | | | X | | | | | | | | | | X | X | |
| Wilkes | X | | | | X | X | X | | X | | | X | X | X | | | X | | | | X | X | | X | X | X |

* Central Piedmont Community College offers only the Freshman year of the pharmacology program.

** Pre-science is a flexible program designed to provide the first two years of college course work for the following majors; astronomy, biology, chemistry, geology, meteorology, and physics.

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[a] North Carolina Department of Community Colleges, Counselor's Guide (Raleigh, N.C., N. C. Department of Community Colleges, January, 1967), p. 81-3.

## TABLE 1 - Continued

| TECHNICAL PROGRAMS 1966-67 | Accounting | Ag. Business | Ag. Equipment | Air Conditioning | Animal Hospitalization | Architectural Drafting | Business Administration | Chemical | Civil | Commercial Art | Dental Hygiene | Dental Laboratory | Drafting & Design—Furn. | Drafting & Design—Mech. | Electrical | Electronics | E. D. P.—Business | E. D. P.—Scientific | Fire and Safety | Fire Science | Food Processing | Forest Management | Furniture Manufacturing | Industrial Engineering | Industrial Management | Library Assistant | Manufacturing | Marine | Mechanical & Production | Nursing | Ornamental Horticulture | Printing Administration | Poultry and Livestock | Sanitary | Secretarial—Eng. & Tech. | Secretarial—Executive | Secretarial—Legal | Secretarial—Medical | Soil and Water Conservation | Textile | Traffic & Transportation | Transportation Maintenance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COMMUNITY COLLEGES | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Central Piedmont | X | | | | | | X | X | X | X | X | | | X | X | X | X | X | | X | | | | | | | X | | | X | | | | | | X | | | | | X | |
| College of the Albemarle | | | | | | | X | | | | | | | X | | X | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Davidson County | | | | | | | X | | | | | | | X | X | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| Gaston College | | | | | | | X | X | X | | | | | | X | X | | | | | | | | X | | | | | X | | | | | | | X | X | | | | | |
| Isothermal | X | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| Lenoir County | X | X | | | | | X | X | | | | | | X | | X | | | | | | | | | | | | | | | X | | | | | X | | | | | | |
| Rockingham | | | | | | | X | | | | | | | X | | | X | | | | | | | | | | X | | | X | | | | | | X | | | | X | | |
| Sandhills | X | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | X | X | X | | | | |
| Southeastern | X | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | X | X | X | | | | |
| Surry | | X | | | | | X | | | | | | | X | | X | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| Western Piedmont | X | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | X | | X | | | | |
| Wilkes | X | X | | | | | X | | | | | | | | | | X | | | | X | | | | X | | | | | | | | X | | | X | X | | | | | |
| TECHNICAL INSTITUTES | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asheville-Buncombe | | | | | | | X | X | X | | | | | X | | X | X | | | | | | | | | | X | | | | | | | | | X | | | | | | |
| Caldwell | | | | | | | X | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | X | | X | | | | |
| Cape Fear | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | |
| Catawba Valley | X | X | | | | X | X | | | | | | X | X | | X | | | | | | | | | | | | | | | | | | | | X | X | X | | | X | |
| Central Carolina | | X | | | X | | X | | | | | | | X | | X | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Durham | | | | | | | X | | X | | | X | | X | | X | | | | | | | | | | | | | | | | | | | | X | X | X | | | | X |
| Fayetteville | X | X | | X | | | X | | X | | | | | X | | X | | | | | | | | | | | | | | | | | | X | X | X | | | | | | |
| Forsyth | | X | | | | | X | | | | | | | X | | X | | | | | | | | | | | X | | | | X | X | | | | X | | | | | | |
| Guilford | X | | | | | | X | | X | X | | | | X | | X | | | | | | | X | | | | | | | | | | | | | X | X | X | | | | |
| Pitt | X | X | | | | X | X | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | X | X | X | | | | |
| Randolph | | X | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Richmond | | | | | | | X | | | | | | | | | X | X | | | | | | | | | | | | | | | | | | X | X | | | | | | |
| Rowan | | | | | | | X | | | | | | | X | | X | | | X | | | | | | | | X | | | | | | | | | X | | X | | | | |
| Alamance | | | | X | | | X | X | | X | | | | X | | X | X | X | | | | | | | | | X | | | | | | | | X | | | X | | | | |
| Wayne | X | | | | | | X | | | | X | | | X | | X | | | | | | X | | | | | | | | | | | X | | | X | | X | X | | | |
| Wilson County | X | | X | X | | | | | | | | | | X | | X | | | | | | | | | | | | | | | | | | | | X | | | | | | X |
| W. W. Holding | | | | | | | | | X | | | | | | | | X | | | | | | | | | | | | | | | | | | | X | X | X | | | | |
| IND. ED. CENTERS & UNITS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Onslow County I. E. C. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ansonville Unit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Carteret County Unit | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| Cleveland County Unit | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Craven County Unit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| Haywood County Unit | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| Jackson County Unit | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| James Sprunt Institute | X | | | | | | X | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| Marion-McDowell Unit | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pamlico County Unit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Robeson County Unit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| Sampson County Unit | X | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | | | | |
| Tri-County Unit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Washington-Beaufort Unit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

POOR ORIGINAL COPY - BEST AVAILABLE AT TIME FILMED

TABLE 1 - Continued

| VOCATIONAL PROGRAMS 1966-67 | Air Cond. & Refri. Service | Auto Body Repair | Auto Mechanics | Carpentry | Cosmetology | Court Reporting | Dental Assistant | Diesel Mechanics | Drafting—Building Trades | Drafting—Mechanical | Elec. Install. & Maint. | Electric Lineman | Farm Machinery Mechanics | Farriering (Horseshoeing) | Graphic Arts—Printing | Heavy Equip. Operator | Hospital Ward Clerk | Knitting Machine Fixing | Machinist | Maintenance—Electromech. | Marine Mechanics | Masonry | Medical Lab. Assistant | Nurses' Assistant | Practical Nursing | Production Assist. (Furn.) | Psychiatric Aide | Radio & TV Servicing | Secretarial | Sewing Machine Mechanic | Sheet Metal | Tool & Die Making | Upholstering | Upholstery Sewing | Welding |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COMMUNITY COLLEGES | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Central Piedmont | X | X | X | | | | X | | | | | | | | | | | | X | | | | | | X | | | | | | | | | | X |
| College of the Albemarle | | | X | | | | | | | | | | | | | | | | X | | X | | | | X | | | | | | | | | | X |
| Davidson County | | X | X | | | | | | | X | X | | | | | | | | X | | | | | | | | | X | | | | | | | |
| Gaston College | X | | X | | | | | | | X | X | | | | | | | | X | | | | | | | | | | | | | X | | | X |
| Isothermal | | | X | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | X |
| Lenoir County | X | | X | | X | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | X |
| Rockingham | | | X | | | | | | | | | | | | | | | | X | | | | | | | | | | X | | | | | | X |
| Sandhills | | X | X | | | | | | X | X | | | | | | | | | | | | | | | | | | X | | | | | | | |
| Southeastern | | | X | | | | | | | | | | | | | | | | X | | | | | | X | | | X | | | | | | | X |
| Surry | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Western Piedmont | | | X | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wilkes | | | X | | | | | | | | | | | | | | | | | | | | | | X | | | X | | | | | | | |
| TECHNICAL INSTITUTES | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asheville-Buncombe | X | | X | X | | | | X | | | | | | | | | | | X | | | | | | X | | | | | | | X | | | X |
| Caldwell | | | X | | X | | | | | X | X | | | | | | | | | | | | | | X | X | | | | | | | | | X |
| Cape Fear | X | | | | | | | | | X | | | | | | | | | X | | X | | | | X | | | X | | | | | | | |
| Catawba Valley | | | X | | | | | | | | X | | | | | | | X | X | | | | | | X | | | X | | | | | X | X | |
| Central Carolina | | | X | | | | | | | | | X | | | | | | | | X | | | | | X | | | | | | | | | | |
| Durham | | | X | | | | | | X | | | | | | | | | | | | | | | | X | | | | | | | | | | |
| Fayetteville | X | | X | | | | | | | | | | | | | | | | X | | | | | | X | | | X | | | | X | | | X |
| Forsyth | | | X | | | | | X | X | | | | | | X | | | | X | | | | | | X | | | X | | | | | | | X |
| Guilford | X | | X | | X | | | | | X | | | | | | | | | X | | | | | | X | | | | | | X | | X | X | X |
| Pitt | | | X | | | | | | | | | | | X | | | | | X | | | | | | X | | | X | | | | | | | |
| Randolph | | | X | | | | | | | X | X | | | | | | | | X | | | | | | X | | | | | | | | | | X |
| Richmond | | | X | | | | | | X | X | | | | | | | | | X | | | | | | X | | | | | | | | | | |
| Rowan | X | | X | | | | | | | X | X | | | | | | | | X | | | | | | X | | | X | | X | | | | | X |
| Alamance | | | X | | | | X | | | | | | | | | | | | X | | | | | | X | | | | | | | | | | |
| Wayne | | | X | | | | X | X | | | | X | | | | | | | | | | | | | X | | X | | | | | | | | |
| Wilson County | | | X | | | | | | | | | X | | | | X | | | X | | | | | | X | | | | | | | | | | X |
| W. W. Holding | | | X | | | X | | | X | X | X | | | | | | | | X | | | | X | | X | | | X | | | | | | | |
| IND. ED. CENTERS & UNITS | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | |
| Onslow County I. E. C. | X | | X | | | | | | | | | | | | | | | | | | | | | | X | | | X | | | | | | | X |
| Ansonville Unit | | | X | | | | | | | | X | | | | | | | | | | | X | | | | | | | | | | | | | X |
| Carteret County Unit | | | | | | | | | | X | | | | | | | | | | | X | | | | X | | | | | | | | | | X |
| Cleveland County Unit | | | X | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | X |
| Craven County Unit | | | | | | | | | | | | | | | | | | | X | | | | | | X | | | | | | | | | | |
| Haywood County Unit | X | | X | | | | | | | | X | | | | | | | | | | | | | | X | | | | | | | | | | |
| Jackson County Unit | | | X | | | | | | | X | | | | | | | | | | | | X | | | | | | X | X | | | | | | |
| James Sprunt Institute | X | | X | | X | | | | | X | X | | | | | | | | | | | X | | | X | | | X | | | | | | | X |
| Marion-McDowell Unit | | | X | | | | | | | X | | | | | | | | | | | | | | | | | | | X | | | | | | |
| Pamlico County Unit | | | | | | | | | | | | | | | | | | | | | X | X | | | | | | | | | | | | | |
| Robeson County Unit | | | | | | | | | | X | | | X | | | | | | | | | | | | X | | | | | | | | | | X |
| Sampson County Unit | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | |
| Tri-County Unit | | | | X | | | | | | | | | | | | | | | | | | X | | | | | | | X | | | | | | |
| Washington-Beaufort Unit | | | X | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | |

Some curricula are tailored to the requirements of particular industries which may or may not be characterized by large numbers of employers in specific local areas. A set of these curriculum-industry combinations is presented in Table 2. Following Bunting's lead in assuming the county as the relevant labor market area, indexes of employment concentration were calculated by county for the largest establishment in each curriculum-industry ($K_1$) and for the largest four establishments ($K_4$). $K_1$ and $K_4$ are, of course, arbitrarily selected measures of concentration. Theory provides little guidance in determining at what point (percent of concentration or value of a Lorenz curve) market behavior begins to approximate competitive as compared to monopsony or monopsony cartel behavior.

$K_1$ and $K_4$ for each curriculum-industry in each area were estimated from the size distribution of firms in County Business Patterns, 1966 and 1967.[10] These data, based on BOASI reports, represent average employment during the pay period containing the 12th of March, 1966 and 1967. Employment in the highest open-ended class (500 employees or more) was estimated by subtracting the sum of those employed in all of the other classes from the reported total employment; assuming the mean establishment size in each size class approximated its midpoint. In those instances in which the open-ended class contained more than one establishment, the relative distribution of establishment size from the 1968 North Carolina Directory of Manufacturing Firms[11] was applied to distribute employment

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[10] U. S. Bureau of the Census, County Business Patterns, North Carolina CBP-66-35 and U. S. Government Printing Office, Washington, D. C., 1967 and 1968.

[11] North Carolina Department of Labor, North Carolina Directory of Manufacturing Firms (Durham, N. C., Christian Publishing Company, 1968).

Table 2

Selected Curricula with Matching Industrial Sectors[a]

| Code | Curricula Title | Industries SIC Number | Title |
|---|---|---|---|
| T45<br>E63<br>E64<br>E76 | Electronic Engineering Technology<br>Electrical<br>Electronics<br>Electrical/Electronics | 36<br>5006<br>524 | Electrical Machinery<br>Electrical Equipment and Supplies (Wholesale)<br>Electrical Supply Stores (Retail) |
| T37<br>E61 | Chemical Technology<br>Chemicals | 28 | Chemicals and Allied Products (excl. the Drug, Soap and Paint Industries - 283-285 inclusive) |
| T75<br>E88 | Furniture Manufacturing Technology (incl. T42-Furniture Drafting and Design, V14-Drafting: Furniture, and V40-Production Assistant: Furniture)<br>Woodworking | 25 | Furniture and Fixtures |
| T50<br>V32<br>E80 | Manufacturing Engineering Technology<br>Machinist<br>Metalworking | 19-39 Inclusive | Manufacturing |
| E87 | Textiles | 22 | Textile Mill Products |

[a] U. S. Bureau of the Budget, Standard Industrial Classification Manual, 1967, U. S. Government Printing Office, 1967; North Carolina Department of Community Colleges, Counselor's Guide, (Raleigh, N. C., Unnumbered Pamphlet, Department of Community Colleges, January, 1968).

among the various firms. The Directory contains a more detailed size distribution than available in County Business Patterns; including the following categories:

501 - 1000 employees
1001 - 1500 employees
1501 - 2500 employees
2501 - 3500 employees
3501 or more employees.

Where the Directory, which is compiled by a mail questionnaire, proved to be incomplete, establishments in the open-ended class were assumed to be equal in size; thus understating $K_1$. The influence of the assumption of equality of establishment size on $K_4$ is not clear. Despite the crudeness of the estimating procedure, it was expected that the resulting estimates would catch at least the rank order of concentration in the various county labor markets (for either $K_1$ or $K_4$) and that the influence of these differences in concentration would emerge in the subsequent analysis.

There is a more important difficulty with this method of measuring relative degrees of monopsony power. The theoretically relevant "K's" relate not to total employment in the industry but to total employment of the particular skill group in the industry (by market area). Thus, the procedure above implicitly assumes a similarity in production functions and relative factor prices within and between the various labor markets. The "true" K's, therefore, may be inaccurately measured by this technique.

Ideally, one would like to have an index of demand from industry for particular curricular offerings at the time each curriculum was instituted in each county. An initial attempt was made to secure these data from the administrators of the various community colleges and technical institutes in North Carolina. Copies of the mail questionnaire and the covering letter are included in Appendix A. Personnel turnover, a fifty percent usable response rate, and substantial and obvious differences in the interpretation of "demand" by the respondents made use of these data questionable. Because of the inability of the various institutions to identify the intensity of industry desires, the existence or non-existence of the relevant curriculum was taken as a crude proxy for industry demand.

## A North Carolina Test - The Basic Analysis

Table 3 shows the pattern of curricular offerings during 1967-68 in five technical and vocationalcurriculum-industries. These five constitute an important part of manufacturing employment in North Carolina.[12] The 44 county labor markets with active institutions in 1967-68 can be divided into four categories:

1. Counties with the relevant curriculum-industry, but without the curriculum,
2. Counties with the curriculum-industry and the curriculum,
3. Counties without the curriculum-industry, but with the curriculum, and
4. Counties without neither the industry or the curriculum.

Categories 1 and 2 provide the basis for a crude test of the influence of relative competitiveness on the incidence of publicly supported training. "t" tests were conducted on the difference in the mean

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[12] Only two institutions offer training in some aspect of textile production and only three in some aspect of the apparel industry. These two industries constitute the first and third largest employers of manufacturing workers in the state according to the N. C. Bureau of Employment Security.

## Table 3

### Distribution of Selected Curricula By County Characteristics Among the 44 Counties With Operating Institutions, 1967-68[a]

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| Curriculum-Industry | With Industry, but Without Curriculum | With Industry and With Curriculum | Without Industry, but With Curriculum | Without Industry and Without Curriculum |
|---|---|---|---|---|
| T45 Electronics | 6 | 16 | 6 | 16 |
| T37 Chemicals | 10 | 4 | 3 | 27 |
| T75 Furniture Manufacturing (incl. T42, V14, & V40) | 20 | 3 | 0 | 21 |
| V32 Machinist | 22 | 22 | 0 | 0 |
| T50 Manufacturing | 37 | 7 | 0 | 0 |

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[a] North Carolina Department of Community Colleges, Counselor's Guide (Raleigh, N. C., Unnumbered Pamphlet, Department of Community College, 1968).

concentration ratio of the WITHOUT and WITH groups for each of the five curricula. F tests were also conducted on the variances of the two groups.

These first crude test results, presented in Table 4, are both encouraging and illuminating. Significant "t's" were found at the .05 level in most curriculum-industries; providing some support for the Becker-Mincer-Reder hypothesis. Particularly low "t's" were found only for T37; a curriculum-industry served by only 4 courses in the entire 44 counties. The F tests show considerable diversity with no apparent pattern in the variances; that is, $S_1^2 \gtrless S_2^2$. These tests and an examination of the concentration ratios in category 1 and category 2 by curriculum-industry suggest two aspects of the analysis heretofore largely neglected.

First, given the presence of publicly supported institutions offering training or potential training in an occupation of interest, monopsonists as well as competitive employers would be induced to utilize the facilities In addition to its other benefits, publicly financed training also provides free screening of potential workers. Unless monopsonists or monopsony cartelists possessed special cost or return advantages to their "own" training relative to cost of hiring the products of the publicly supported facility, one would expect monopsony employers to utilize and even to encourage publicly financed training. Special advantages of "own" training might include benefits from the ability (1) to more closely control course contents, (2) to select prospective students according to criteria not generally employed by public training facilities, and (3) to obtain other benefits which might derive from possible differences in the educational production functions of the firm versus the production function of the institute. Moreover, the existence of a visible mechanism for creating a pool of trained individuals may induce new competitors into the

Table 4

Summary of t and F tests on the Concentration Ratios among Counties with Institutions and the Relevant Industries

| Curriculum-Industry | t tests $K_1$ | $K_4$ | F tests $K_1$ | $K_4$ | df |
|---|---|---|---|---|---|
| T45 | 2.03 | 1.61 | 8.59 | 599. | 20 |
| T37 | .67 | 1.92 | 1.28 | 2.39 | 12 |
| T75 | 2.32 | 4.70 | 1.22 | .77 | 21 |
| V32 | 3.46 | 3.91 | .376 | .834 | 42 |
| T50 | 2.56 | 3.06 | .057 | .199 | 42 |

local labor market. In general, this set of considerations leads one to expect the WITH group to be heterogeneous relative to the WITHOUT group; i.e., one expects $S_2^2 > S_1^2$.

A second set of considerations--largely administrative ones--leads to no presumptions concerning the relative magnitudes of the $S_1^2$'s. In North Carolina, new curricula must be prepared by the local administrative officers in consultation with the local public advisory board and then approved by the State Board of Education upon recommendation of the Department of Community Colleges.[13] Further, where the DCC feels that training in a particular area is of interest to the entire State (say-in growing industries such as electrical machinery and equipment and chemicals), such feelings are communicated to the various local authorities. This communication is thought to be particularly important in those areas outside the industrialized Piedmont. The interplay of ideas and administrative structures could easily lead to considerable diversity within the two groups and to no clear presumption of $S_1^2 \gtrless S_2^2$ among the various curriculum-industries. The F tests are consistent with this line of reasoning.

Despite the encouraging results and the interesting interpretation derivable from these crude tests, the results do not hold constant the influence of a number of factors which one might consider to be correlated with concentration. Thus, a second analytical approach--that of multiple regression--was employed to assess the influence of the K's on the existence or nonexistence of the relevant curriculum given the influences of other factors. These factors include:

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[13] Department of Community Colleges, Policy Manual for the System of Community Colleges (Raleigh, N. C., State Board of Education, Revised May, 1967), Paragraph 4.0211.

1. the size of the industry relative to total employment in the area; another possible measure of market power.
2. the influence of the Department of Community Colleges on the curriculum.

With respect to #2 above, a nonpiedmont dummy was defined to pick up the influence of the Department of Community Colleges on the curriculum in the less well developed areas of the state, the Coastal Plain and the Appalachian region.

Linear cross-sectional regressions for the five curriculum-industries were run in the following form:

$$y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \varepsilon \qquad (18)$$

where $y_i$ = a dummy variable for the presence or absence of the curriculum in each county containing the industry (Presence = 1; absence = 0), (called E below)

$X_{1i}$ = the concentration ratio ($K_1$ or $K_4$) for the relevant industry in 1966 (in percent),

$X_{2i}$ = the percent of total county employment accounted for by the curriculum-industry in 1966 as measured by BOASI data, and

$X_{3i}$ = a dummy for the location of the county (Nonpiedmont = 1, Piedmont = 0).

Regression results for the five curriculum industries are reported in Table 5. The results support the findings of the earlier tests. The magnitude of the coefficients on $K_1$ and $K_4$ ($X_1$) are generally quite small. The coefficient on $X_2$ turns up with the expected sign in most cases and statistical significance in some. The coefficient on $X_3$ may be picking up the influence of the DCC in electronics and in chemicals, but statistical significance is lacking. Despite some encouraging signs, the $R^2$'s are not overwhelmingly high and the encouraging results may be spurious. The data clearly indicate that larger communities, located primarily in the Piedmont, possess both the lowest K's ($X_1$'s) and the widest diversity of industry (the lowest $X_2$'s). Moreover, the tax base for these communities might

## Table 5

Preliminary Regression Results, Coefficients and t Values

| Curriculum-Industry | $\alpha$ | Concentration Ratio<br>$\beta_1$ | Relative Size in Area<br>$\beta_2$ | Nonpiedmont Dummy<br>$\beta_3$ | $R^2$ | Mean $K_1$'s |
|---|---|---|---|---|---|---|
| T45 | 1.43 | -.0072<br>(2.5409) | -.0747<br>(2.2375) | .2029<br>(1.0286) | .349 | $70.79 = \bar{K}_1$ |
| T45 | 1.83 | -.0101<br>(2.1351) | -.0746<br>(2.1341) | .1916<br>(.9320) | .294 | $88.80 = \bar{K}_2$ |
| T37 | .40 | -.0025<br>(.5002) | -.0131<br>(.4091) | .1525<br>(.5234) | .071 | $55.04 = \bar{K}_1$ |
| T37 | 1.13 | -.0106<br>(1.8634) | -.0126<br>(.4882) | .2230<br>(.8688) | .293 | $85.75 = \bar{K}_4$ |
| T75 | .094 | -.0013<br>(.5137) | .0167<br>(2.2077) | -.1080<br>(.7698) | .366 | $53.23 = \bar{K}_1$ |
| T75 | .771 | -.0085<br>(2.6612) | .0041<br>(.5409) | .0418<br>(.3214) | .532 | $81.42 = \bar{K}_4$ |
| V32 | 1.46 | -.0258<br>(3.4057) | -.0105<br>(2.6852) | -.1731<br>(1.1246) | .343 | $13.82 = \bar{K}_1$ |
| V32 | 1.59 | -.0124<br>(3.7794) | -.0100<br>(2.6556) | -.1448<br>(.9578) | .376 | $42.75 = \bar{K}_4$ |
| T50 | .481 | -.0092<br>(1.4963) | -.0017<br>( .5390) | -.1957<br>(1.5596) | .185 | $13.82 = \bar{K}_1$ |
| T50 | .568 | -.0054<br>(1.9899) | -.0018<br>(.5778) | -.1663<br>(1.3423) | .217 | $42.75 = \bar{K}_4$ |

provide for a considerably higher level of service in any curricular area than that in the smaller counties. From the preliminary regression results, it appeared necessary to introduce "standardizers" for population size and the absolute size of the curriculum-industry in each community.

Table 6 shows the results of the various regressions when one includes a county population "standardizer." $R^2$'s, for the various regressions, rise slightly as compared to the matched regressions in Table 5. The population standardizer "hits" both the concentration ratio and the relative size coefficients, lowering t values. These results suggest the presence of a "size" effect being picked up by some of the concentration coefficients. Further experimentation with industry size in each community isolated this effect.

Consider the dimensions of the concentration ratios:

$$K_1 = \frac{N_1}{\sum_{i=1}^{n} N_i}$$

where $N_i$ equals the number of persons employed in each curriculum-industry and where the i firms are ranked in order of size.

$$K_4 = \frac{\sum_{i=1}^{4} N_i}{\sum_{i=1}^{n} N_i}$$

Now the absolute size of the curriculum-industry is $\sum_{i=1}^{n} N_i$. Thus, inclusion of $I = \sum_{i=1}^{n} N_i$ in the regressions provides two types of information. First, it identifies the degree to which the absolute size of the industry raises or lowers the probability of the course being offered; other characteristics being held constant. Second, if the K's sharply lose statistical significance in the presence of I, the previous, perhaps significant, relationship

Table 6

Further Regression Results, Coefficients and t Values

| Curriculum-Industry | $\alpha$ | Concentration Ratios $\beta_1$ | Relative Size in Area $\beta_2$ | Nonpiedmont Dummy $\beta_3$ | Population $\beta_4$ | $R^2$ | Mean $K_1$'s |
|---|---|---|---|---|---|---|---|
| T45 | 1.335 | - .0065<br>(1.492) | - .0706<br>(1.748) | .1993<br>(.980) | (.0004)<br>(.1958) | .350 | 70.79 |
| T45 | 1.892 | - .0101<br>(.834) | - .0765<br>(1.351) | .1941<br>(.8863) | -.0002<br>(.043) | .294 | 88.80 |
| T37 | - .2537 | .0003<br>(.0533) | .0093<br>(.2942) | .3938<br>(1.1083) | .0032<br>(1.1501) | .190 | 55.04 |
| T37 | .9712 | - .0096<br>(1.1612) | - .0115<br>(.4061) | .2587<br>(.7491) | .0005<br>(.1660) | .296 | 85.75 |
| T75 | - .3238 | .0013<br>(.4842) | .0251<br>(3.0942) | -.0965<br>(.7420) | .0021<br>(2.0451) | .485 | 53.23 |
| T75 | .5419 | - .0068<br>(1.5443) | .0082<br>(.7718) | .0272<br>(.2016) | .007<br>(.5619) | .540 | 81.42 |
| V32 | 1.1634 | - .0214<br>(2.2580) | - .0081<br>(1.6312) | -.1334<br>(.8250) | .0013<br>(.7951) | .354 | 13.82 |
| V32 | 1.4633 | - .0115<br>(2.600) | - .0090<br>(1.8425) | -.1314<br>(.8250) | .0005<br>(.3036) | .378 | 42.75 |
| T50 | .2612 | .0019<br>(.2618) | .0043<br>(1.1407) | -.0967<br>(.7850) | .0033<br>(2.6164) | .307 | 13.82 |
| T50 | -.1711 | -.0003<br>(.0872) | .0036<br>(.9413) | -.0900<br>(.7312) | .0031<br>(2.2321) | .306 | 42.75 |

on K would be shown to be the result solely of changes in the denominator of the K ratios--an industry-size effect rather than a concentration effect. This is quite possible since the simple correlations of K and I tend to be high. Inclusion of I in the regression lets K and I "fight it out."

Before presenting the results of the regressions containing I as well as P, $K_1$ or $K_4$, V and NP, it is useful to consider the nature of the observational unit. In the regressions above, the county was identified as the observational unit because there are no geographic areas officially designated as the service (or market) areas of the various community colleges and technical institutes. Presumably the travel-time constraint imposed by the nonresidence character of these institutions provides the effective limits of the market area of each institution. No data, however, are presently available on the location of the employers serviced by each curriculum. Some data are available on the location of students. For our purposes, the county may be too large or too small an area. Moreover, adoption of the county as the observational unit omitted over half the counties in the state even for curriculum industries which were widely dispersed (such as T50 and V32). In order to check the results of using a broader market area, the regressions were re-run with a new observational unit, the adult basic education unit specified in the State Plan.[14] The ABE areas were sometimes coterminous with the counties (21 cases). More often, however, they represent a central urban county together with adjacent less urban counties. The 50 ABE areas (one for each community college and technical institute) encompass all 100 counties in the state.

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[14] North Carolina State Board of Education, North Carolina State Plan for Adult Basic Education (Raleigh, N. C.; State Department of Community Colleges, May 4, 1967).

Table 7 presents matched regressions for the five curriculum-industries on a county and an ABE area basis, including the important "I" variable in the regressions. The results indicate, first, there is little difference between the regression results on a county basis as compared to an ABE area basis. As a crude indicator of the similarity of results, one can note that the $R^2$'s for the counties exceeded those of the ABE's in five cases in the ten matched pairs of regressions. Moreover, in almost all cases, the differences in $R^2$'s were slight. Finally, the regression coefficients did not change substantially as the area of observation was changed. Thus, it would appear that either measure may be used as the unit of observation. On the one hand, the requirement that the counties finance some portion of the community college or technical institute would suggest that we use the county as the observational unit for certain analytical purposes. On the other, one might feel more comfortable using ABE data which reflects all of the counties in the state and, therefore, the entire range of industrial demand.

The regression results by curriculum show rather clearly that the earlier indications of statistical significance on the coefficient of $K_1$ or $K_4$ ($\beta_1$ in the tables) were largely capturing the influence of the size of industry variable. In the presence of industry size (I), $\beta_{E.K_1}$ and $\beta_{E.K_2}$ are negative in only 11 out of the 20 regressions. In the "fight" between $K_i$ and I, I emerges the victor in T45, T75, and T50. No clear conclusion

### Table 7

### Matched Regression Results for Five Curriculum-Industries on a County and an ABE Area Basis

| Curriculum Industry and Unit of Observation | No. of Observations | | Concentration Ratios | Relative Size of Industry in Area | Nonpiedmont Dummy | Population | Industry Size | $R^2$ | Mean $K_i$'s |
|---|---|---|---|---|---|---|---|---|---|
| | | $\alpha$ | $\beta_1$ | $\beta_2$ | $\beta_3$ | $\beta_4$ | $\beta_5$ | | |
| T45 (ABE) | 23 | 1.38 | -.008<br>(1.969) | .080<br>(1.715) | .174<br>(.874) | | .050<br>(.343) | .387 | 67.6 ($K_1$) |
| T45 (County) | 22 | .989 | -.002<br>(.480) | .103<br>(2.560) | .251<br>(1.266) | | .210<br>(1.224) | .401 | 70.8 ($K_1$) |
| T45 (ABE) | 23 | - .010 | .007<br>(.572) | -.122<br>(1.900) | .184<br>(.842) | | .421<br>(1.381) | .268 | 87.8 ($K_4$) |
| T45 (County) | 22 | - .212 | .010<br>(.882) | -.132<br>(2.985) | | | .490<br>(1.921) | .420 | 88.8 ($K_4$) |
| T37 (ABE) | 14 | .216 | -.003<br>(.584) | -.003<br>(.101) | | | .396<br>(1.461) | .332 | 51.2 ($K_1$) |
| T37 (County) | 14 | .047 | .001<br>(.246) | -.022<br>(.721) | | | .410<br>(1.350) | .193 | 55.0 ($K_1$) |
| T37 (ABE) | 14 | - .287 | .003<br>(.270) | -.016<br>(.593) | | | .583<br>(1.317) | .314 | 86.0 ($K_4$) |
| T37 (County) | 14 | 1.457 | -.013<br>(.856) | -.004<br>(.118) | | | .660<br>(.216) | .244 | 85.7 ($K_4$) |
| T75 (ABE) | 29 | - .148 | .002<br>(1.191) | -.006<br>(1.090) | | | .105<br>(5.959) | .713 | 55.5 ($K_1$) |
| T75 (County) | 23 | - .203 | .002<br>(1.122) | -.004<br>(.682) | | | .120<br>(4.699) | .698 | 53.2 ($K_1$) |

## Table 7 - Continued

| Curriculum Industry and Unit of Observation | No. of Observations | $\alpha$ | Concentration Ratios $\beta_1$ | Relative Size of Industry in Area $\beta_2$ | Nonpiedmont Dummy $\beta_3$ | Population $\beta_4$ | Industry Size $\beta_5$ | $R^2$ | Mean $K_1$'s |
|---|---|---|---|---|---|---|---|---|---|
| T75 (ABE) | 29 | - .445 | .004<br>(1.050) | -.006<br>(1.012) | | | .124<br>(3.965) | .709 | 84.8 ($K_4$) |
| T75 (County) | 23 | -1.209 | .012<br>(2.187) | .010<br>(1.623) | | | .210<br>(3.966) | .742 | 81.4 ($K_4$) |
| V32 (ABE) | 44 | .941 | -.022<br>(2.126) | -.008<br>(2.380) | | | .014<br>(2.340) | .366 | 10.9 ($K_1$) |
| V32 (County) | 44 | 1.154 | -.022<br>(2.684) | -.010<br>(2.658) | | | .010<br>(1.739) | .371 | 13.8 ($K_1$) |
| V32 (ABE) | 44 | .947 | -.008<br>(1.853) | -.008<br>(2.247) | | | 0.013<br>(1.888) | .350 | 31.4 ($K_4$) |
| V32 (County) | 44 | 1.336 | -.011<br>(2.824) | -.009<br>(2.569) | | | .013<br>(1.103) | .381 | 42.8 ($K_4$) |
| T50 (ABE) | 44 | -.109 | .003<br>(.356) | -.000+<br>(.009) | | | .018<br>(3.956) | .359 | 10.9 ($K_1$) |
| T50 (County) | 44 | .079 | -.003<br>(.421) | -.001<br>(.438) | | | .020<br>(3.100) | .303 | 13.8 ($K_1$) |
| T50 (ABE) | 44 | -.357 | -.000+<br>(.015) | .005<br>(1.562) | | | .003<br>(2.904) | .320 | 31.4 ($K_4$) |
| T50 (County) | 44 | .124 | -.002<br>(.551) | -.001<br>(.451) | | | .020<br>(2.666) | .305 | 42.7 ($K_4$) |

can be drawn in the case of chemicals, T37, given the low $R^2$'s and the emphemeral nature of statistical significance in these regressions. Only in V32, machinist, did the concentration ratios stand the test; indicating that the larger the concentration ratios ($K_1$ or $K_4$), the lower the probability that the course will be offered; given the absolute size of the industry in the area. Finally, one should note the degree to which T75 is dominated by the industry effect; the high $R^2$'s resulting largely from "I" rather than the other variables. Appendix B reports the simple correlation matrixes for the particular curriculum-industries.

One may summarize the additional results at this juncture as follows:

1. that local industry size has a strong positive effect on the existence of a service curriculum; concentration rates and relative size of the "using" industry held constant.

2. that the relative size of the industry in the area has a negative effect on the existence of the curriculum; given the absolute size of the industry and the concentration rates.

3. that the nonpiedmont dummy has little explanatory power in the presence of I, V, and $K_i$.

Each of the additional results will be discussed in turn; beginning with the strong positive effect of local industry size on the existence of the appropriate curriculum. Unfortunately, the regression results cannot tell us (1) whether the influence was "local" in the sense that officials of the educational institutions were responding to the economic weight of local industry demanders or (2) whether the influence was related largely to the state requirement that local consumers of the educational product be identified before official approval is given for new curricula.

Although the user requirement is not always involved, it represents an important element in obtaining "state" approval for new educational programs. Obviously, it is easier to show "consumer demand" in these terms, the larger the size of the prospective using industry. Thus, $\beta_{E.I}$ may largely reflect this state requirement. Regardless of the mechanics of the process, the existence of a curriculum in a given area would appear to be heavily influenced by the absolute size of a "local" user group.

At first blush, it is difficult to rationalize the negative and often statistically significant coefficients on "V" -- the relative size of the using industry in the local area. One interpretation makes considerable sense. Given "I" and given $K_1$ or $K_4$, which are usually quite high in these small areas, "V", the relative size of the industry, may serve as a good proxy for a dimension of monopsony power; a dimension not well measured by $K_1$ or even by $K_4$. Given "I" and $K_i$, "V" might easily represent the opportunities for effective labor market cartelization; overt or tacit. Wherever the industry was large relative to total employment, "V" represents the degree to which the community is an "industry town" with limited alternative employment opportunities in other industries. Thus, "V" serves as a proxy for formal or informal monopsony cartel influences. An alternative interpretation of $\beta_{E.V}$-- that the leading industrialists will impose their training needs on the local educational institutions -- would imply that $\beta_{E.V} > 0.0$. This interpretation is not supported by the regression results.

One cannot generalize very much from these results concerning the degree to which state priorities as against "local" influence are operating in the existence of the various curricula. An aspect of this was discussed above in considering the influence of I. It is clear, however, that the nonpiedmont dummy--interpreted as a policy variable--did not seem to play a significant role in curriculum determination with reference to these five curricula. In order to perform a more satisfactory test of the proposition that statewide priorities have little or no influence, one would need a much richer data bank concerning interactions between state planners and local officials and pressure groups than is now available.

## A North Carolina Test--Further Analytical Considerations and Regressions

One avenue of potentially fruitful inquiry is suggested by labor market theory and by the regression results on V32 as compared with the results on the "T" curricula.

Labor market theory suggests that the labor market should be geographically broader, the higher the level of education.[15] Thus, as one moves up the educational ladder, the growing size of the labor market tends to counteract the tendency toward monopsony within the local market. Alternatively stated, while the market for unskilled workers tends to be geographically narrow with a large number of competing employers (a la Bunting's work), the wider horizons and the broader institutionalized and informal contacts usually attributed to education counter to some degree the monopsony power by local employers which would otherwise exist in the same local market for skilled workers. To the degree that the denominator of the concentration ratio increases in size more rapidly than the numerator as the market widens with increases in skill level, the degree of monopsony power would decline. It is conceivable that the degree of labor market monopsony is parabolic with skill levels--rising from a low degree with unskilled workers to a high in the middle range of vocational and technical skills and then falling to a low for most professional or highly skilled technical workers (such as doctors and engineers). It is, of course, conceivable that market size and the diminishing employment opportunities in any local area (both of which are functions of skill level) offset each other, so that monopsony is low across the entire spectrum of skills. The importance of the $K_i$ variables in V32 regression sets as compared with the four "T" regression sets may provide some evidence of a curvilinear monopsony relationship.[16]

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[15] Assuming that the markets for the greater skill levels are not regulated by trade union restrictions, local or state licensing or certification procedures, or other monopoly constraints. For an interesting approach to the problem of market size and level of education, see Theodore Lianos, Educational Selectivity of Migration, Unpublished Master's thesis, North Carolina State University, 1967.

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[16] It is obviously difficult to examine the size of the relevant labor market among the various curricula. In principle, one would want to obtain information on the relative elasticities of supply of each skill group to various geographic areas in order to determine the relevant market areas. Such information is not available at this time. One can obtain some insight into the size of the market for any given skill group, however, by observing the geographic distribution of graduates. For example, A. B. Carroll showed that none of his sample of the 45 graduates of Gastonia Technical Institute in 1959-60 subsequently were employed in the local area--Gaston County or the Gaston ABE area. See A. B. Carroll, Value of Human Capital Created by Investments in Technical Education, Unpublished Ph.D. dissertation, N. C. State University, Raleigh, N. C. 1966, pp. 86-88. Twelve of the 45 technicians were employed outside the state at the time of the survey (all 12 in Virginia). Only 6 of the graduates were employed within a 30 mile radius of the school (assuming that all graduates living in a county bifurcated by the circle lived within the circle). Thus, 1/9th is the maximum local "take" from the 1959-60 graduating class--where local

Additional insight into the influence of local labor market monopsony might be obtained by looking at "extension courses" at the various technical institutes and contrasting the regression results on the $K_i$'s and V's with these obtained in the regressions on the technical and vocational curricula.

Many of the North Carolina technical institutes had their origin in the old Industrial Education Centers, which stressed service to individuals who were already employed or to those preparing for immediate employment at a new plant. This tradition is now carried on through the extension courses. Thus, via an examination of the extension courses, one may be able to more closely identify the influence of changing labor market conditions on the shift from privately financed training, or no training, to publicly financed training.

Three quotations from the 1963 IEC Guide[17] provide the background for this examination. They are:

> "The location of new Centers will take into consideration the proximity of industrial establishments with workers who desire extension training and the distances students will have to travel to attend day or evening classes."[18]

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is defined as a circle 60 miles in diameter.

It's important to note that figures from "Gaston Tech" may be somewhat atypical of the entire system; given the well-established reputation of the Institute and given its former ties with North Carolina State University (then N. C. State College).

[17] North Carolina Department of Curriculum Study and Research, A Guide to the Further Development of Industrial Education Centers in North Carolina, (Raleigh, N. C.; State Board of Education, January 3, 1963).

[18] *Ibid.*, p. 8.

> "Training programs in the Centers have been developed to date (1963) largely on the basis of needs ascertained through local surveys, with the benefit of state-wide, detailed planning on a large scale."[19]

> "Each curriculum, technical or trade, in each Center will gear into the state-wide program and contribute its part in meeting state-wide needs."[20]

In particular, the "needs" were ascertained through the North Carolina Study of Technical and Skilled Manpower, conducted by the Employment Security Commission for the State Board of Education.[21] The strong findings on the influence of the "industry" variable in each of the five curriculum industries investigated above certainly supports the proposition that the various curricula are instituted where the using industry is located.

It should be noted that the "local" areas contained in the ESC study are not synonymous with the various counties or with the various ABE areas. For the purpose of the ESC study, the state was divided into six areas--each encompassing a number of counties. Chart 1 shows these areas together with the location of the offices of the N. C. Employment Security Commission and the existing or proposed IEC's in June 1962.

Using data from the official unpublished records of the North Carolina Department of Community Colleges,[22] the existence or nonexistence of each

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[19] Ibid., p. 7.

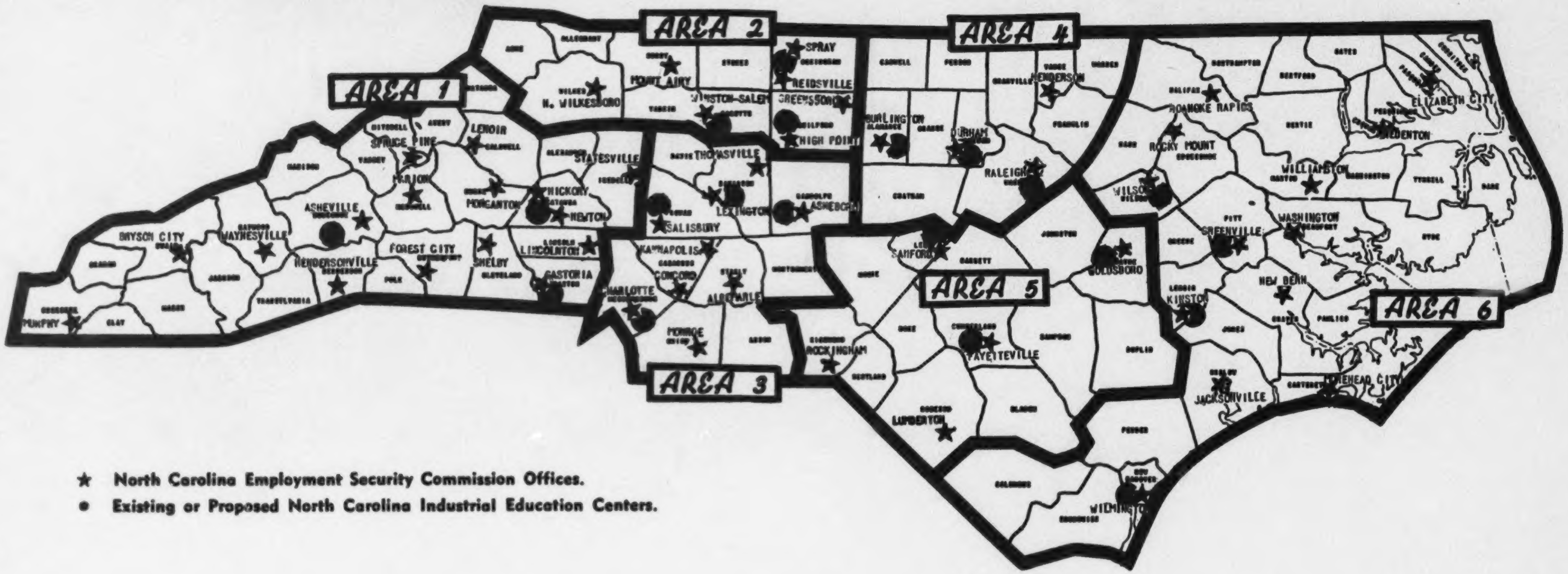
[20] Ibid., p. 8.

[21] Bureau of Employment Security Research, North Carolina Study of Technical and Skilled Manpower (Raleigh, N. C., Employment Security Commission of North Carolina, June 1962).

[22] Mr. Julian Wingfield of the Department of Community Colleges provided these data together with the information concerning the collection and collation procedures.

## CHART 1

## Areas of State Designated for Distribution of State Wide Survey Findings


AREA 1
AREA 2
AREA 3
AREA 4
AREA 5
AREA 6
MURPHY
BRYSON CITY
WAYNESVILLE
ASHEVILLE
HENDERSONVILLE
SPRUCE PINE
MARION
LENOIR
MORGANTON
FOREST CITY
SHELBY
HICKORY
NEWTON
STATESVILLE
LINCOLNTON
GASTONIA
CHARLOTTE
KANNAPOLIS
CONCORD
SALISBURY
ALBEMARLE
MONROE
N. WILKESBORO
MOUNT AIRY
WINSTON-SALEM
THOMASVILLE
LEXINGTON
ASHEBORO
HIGH POINT
GREENSBORO
REIDSVILLE
SPRAY
BURLINGTON
DURHAM
RALEIGH
HENDERSON
ROCKINGHAM
SANFORD
FAYETTEVILLE
LUMBERTON
GOLDSBORO
WILMINGTON
JACKSONVILLE
KINSTON
NEW BERN
MOREHEAD CITY
GREENVILLE
WASHINGTON
WILSON
ROCKY MOUNT
ROANOKE RAPIDS
WILLIAMSTON
EDENTON
ELIZABETH CITY
★ North Carolina Employment Security Commission Offices.
● Existing or Proposed North Carolina Industrial Education Centers.

[a] North Carolina Department of Curriculum Study and Research, A Guide to Further Development of Industrial Education Centers in North Carolina (Raleigh, N. C., State Board of Education, January 3, 1963), p. 24, Figure 2.

T, V, and E curriculum, listed in Table 2 above by quarters during the 1967-68 academic year, was regressed on the relevant labor market variables for the first quarter of 1967, the most recent available data from the BOASI. Two dependent variables were identified--TAU and OFF. TAU, a 1-0 qualitative variable, indicated whether the particular curriculum was actually taught during the quarter at a given institute or college; OFF, also a 1-0 variable for each quarter, indicated whether or not the curriculum was offered in at least one quarter during the year. Since the cumulative count for OFF begins anew each fall, TAU and OFF are identical for the fall quarter.[23]

Tables 8 and 9 show the coefficients and standard errors for the various quarterly regressions. The conclusions reached above for the T and V regressions are largely supported by the quarterly results in Table 8. Although statistical significance on $\beta_{E.K_1}$ and $\beta_{E.K_4}$ are often lacking, the sign of the coefficient is usually negative as expected. The coefficient on V, the relative size of the using industry in the community, also is usually negative. Moreover, it is statistical significant at the .05 level in a number of cases--particularly with T45 and V32. The coefficient on absolute industry size holds up even when quarterly data are employed--providing most of the explanatory power in T37, T75, and T50; a result similar to that cited above from the data presented in the Curriculum Guide.

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[23] There are a set of special statistical problems associated with the use of ordinary least squares regression analysis with dichotomous dependent variables. These problems are discussed in the chapter III.

## TABLE 8

### Coefficients and Standard Errors--Selected Regressions on Technical and Vocational Curricula by Quarters (Wingfield Data for 1967-68)

| Curriculum-Industry | TAU or OFF | Quarter | Coefficients and Standard Errors $K_1$ | $K_4$ | V | I | $R^2$'s |
|---|---|---|---|---|---|---|---|
| T45 | TAU<br>OFF | 1st & 2nd<br>1st, 2nd, 3rd & 4th | -.006<br>(.004) | | -.085<br>(.040) | .080<br>(.121) | .38 |
| | | | | .001<br>(.010) | -.105<br>(.044) | .220<br>(.183) | .33 |
| | TAU | 3rd | -.003<br>(.003) | | -.084<br>(.026) | .186<br>(.018) | .21 |
| | | | | -.004<br>(.090) | .080<br>(.033) | .216<br>(.168) | .12 |
| | TAU | 4th | -.004<br>(.004) | | -.092<br>(.039) | .193<br>(.118) | .48 |
| | | | | -.005<br>(.010) | .097<br>(.042) | .216<br>(.176) | .46 |
| T37 | TAU<br>OFF | 1st, 2nd<br>1st, 2nd | -.002<br>(.004) | | -.055<br>(.065) | .450<br>(.234) | .36 |
| | | | | -.006<br>(.007) | -.048<br>(.066) | .319<br>(.330) | .36 |
| | TAU | 3rd | -.004<br>(.004) | | -.052<br>(.067) | .385<br>(.253) | .36 |
| | | 3rd | | -.006<br>(.007) | -.052<br>(.067) | .301<br>(.341) | .36 |
| | OFF | 3rd | -.001<br>(.004) | | .001<br>(.064) | .548<br>(.240) | .42 |
| | | 3rd | | .000+<br>(.007) | -.001<br>(.066) | .560<br>(.233) | .42 |
| | TAU | 4th | .003<br>(.004) | | .111<br>(.066) | .502<br>(.251) | .20 |
| | | 4th | | -.001<br>(.007) | .131<br>(.064) | .569<br>(.323) | .27 |
| | OFF | 4th | -.001<br>(.004) | | .002<br>(.065) | .548<br>(.248) | .42 |
| | | 4th | | -.000+<br>(.007) | -.001<br>(.066) | .560<br>(.333) | .42 |

TABLE 8 Continued

| Curriculum Industry | TAU or OFF | Quarter | Coefficients and Standard Errors<br>$K_1$ | <br>$K_4$ | <br>V | <br>I | $R^2$'s |
|---|---|---|---|---|---|---|---|
| T75 | TAU | 1st | -.001<br>(.002) | | -.005<br>(.010) | .071<br>(.027) | .42 |
| | OFF | 1st, 2nd, 3rd, 4th | | .000+<br>(.004) | -.004<br>(.010) | .080<br>(.037) | .41 |
| | TAU | 2nd, 3rd | -.000<br>(.002) | | -.005<br>(.007) | .082<br>(.019) | .60 |
| | | | | -.001<br>(.003) | -.005<br>(.007) | .078<br>(.023) | .60 |
| | TAU | 4th | -.000<br>(.001) | | .018<br>(.005) | -.015<br>(.015) | .14 |
| | | | | .001<br>(.002) | .018<br>(.005) | -.007<br>(.020) | .16 |
| T50 | TAU | 1st | .006<br>(.008) | | .003<br>(.003) | .013<br>(.005) | .18 |
| | OFF | | | .003<br>(.004) | .003<br>(.003) | .014<br>(.005) | .18 |
| | TAU | 2nd | -.001<br>(.007) | | -.001<br>(.003) | .015<br>(.004) | .31 |
| | | | | .001<br>(.004) | -.001<br>(.003) | .017<br>(.005) | .31 |
| | OFF | 2nd, 3rd 4th | .003<br>(.008) | | .000<br>(.003) | .016<br>(.005) | .25 |
| | | | | .002<br>(.004) | .000<br>(.003) | .017<br>(.005) | .25 |
| | TAU | 3rd | .001<br>(.007) | | .002<br>(.003) | .012<br>(.004) | .23 |
| | | | | .001<br>(.003) | .002<br>(.003) | .013<br>(.005) | .23 |
| | TAU | 4th | .003<br>(.006) | | .003<br>(.003) | .014<br>(.004) | .31 |
| | | | | -.002<br>(.003) | .003<br>(.003) | .014<br>(.004) | .31 |

TABLE 8 Continued

| Curriculum Industry | TAU or OFF | Quarter | Coefficients and Standard Errors |  |  |  | $R^2$'s |
|---|---|---|---|---|---|---|---|
|  |  |  | $K_1$ | $K_4$ | V | I |  |
| V32 | TAU and OFF | 1st | -.019<br>(.010) |  | -.012<br>(.004) | .012<br>(.006) | .29 |
|  |  |  |  | -.011<br>(.005) | -.013<br>(.004) | .008<br>(.007) | .31 |
|  | TAU | 2nd | -.010<br>(.005) |  | -.008<br>(.004) | .013<br>(.006) | .36 |
|  |  |  |  | -.014<br>(.009) | -.007<br>(.004) | .017<br>(.006) | .34 |
|  | OFF | 2nd | -.021<br>(.009) |  | -.011<br>(.004) | .016<br>(.005) | .39 |
|  |  |  |  | -.012<br>(.005) | -.011<br>(.004) | .012<br>(.006) | .42 |
|  | TAU | 3rd | -.016<br>(.009) |  | -.009<br>(.004) | .016<br>(.005) | .34 |
|  |  |  |  | -.008<br>(.004) | -.009<br>(.004) | .014<br>(.006) | .33 |
|  | OFF | 3rd | -.012<br>(.009) |  | -.008<br>(.004) | .017<br>(.006) | .32 |
|  |  |  |  | -.008<br>(.005) | -.008<br>(.004) | .014<br>(.007) | .33 |
|  | TAU | 4th | -.023<br>(.009) |  | -.011<br>(.004) | .014<br>(.005) | .42 |
|  |  |  |  | -.011<br>(.005) | -.011<br>(.004) | .012<br>(.006) | .40 |
|  | OFF | 4th | -.011<br>(.009) |  | -.008<br>(.004) | .016<br>(.006) | .32 |
|  |  |  |  | -.009<br>(.005) | -.009<br>(.004) | .013<br>(.006) | .33 |

TABLE 9

Coefficients and Standard Errors--Selected Regressions on Extension Curricula by Quarters (Wingfield Data for 1967-68)

| Curricula Industry | TAU or OFF | Quarter | Coefficients and Standard Errors | | | | $R^2$'s |
|---|---|---|---|---|---|---|---|
| | | | $K_1$ | $K_4$ | V | I | |
| E63 | TAU and OFF | 1st | .000 | | -.017 | -.026 | .05 |
| | | | (.003) | | (.029) | (.087) | |
| | | | | .002 | -.019 | -.008 | .05 |
| | | | | (.007) | (.030) | (.013) | |
| | TAU | 2nd | .005 | | -.026 | .081 | .15 |
| | | | (.003) | | (.027) | (.082) | |
| | | | | .004 | -.017 | .030 | .04 |
| | | | | (.007) | (.031) | (.127) | |
| | OFF | 2nd | .003 | | -.033 | .015 | .10 |
| | | | (.004) | | (.034) | (.101) | |
| | | | | .003 | -.031 | .006 | .08 |
| | | | | (.008) | (.036) | (.149) | |
| | TAU | 3rd, 4th | .003 | | -.009 | .040 | .07 |
| | | | (.002) | | (.020) | (.062) | |
| | | | | .002 | -.005 | .016 | .02 |
| | | | | (.005) | (.022) | (.093) | |
| | OFF | 3rd, 4th | .003 | | -.033 | .015 | .10 |
| | | | (.004) | | (.034) | (.101) | |
| | | | | .003 | -.030 | .006 | .08 |
| | | | | (.008) | (.036) | (.149) | |
| E64 | TAU & Off | 1st | -.003 | | -.033 | -.070 | .12 |
| | | | (.004) | | (.033) | (.100) | |
| | | | | .008 | -.056 | .115 | .13 |
| | | | | (.008) | (.035) | (.115) | |
| | TAU | 2nd | .005 | | -.010 | .184 | .16 |
| | | | (.004) | | (.032) | (.098) | |
| | | | | .011 | -.016 | .252 | .16 |
| | | | | (.008) | (.034) | (.143) | |

TABLE 9 Continued

| Curricula Industry | TAU or OFF | Quarter | Coefficients and Standard Errors | | | | R$^2$'s |
|---|---|---|---|---|---|---|---|
| | | | $K_1$ | $K_4$ | V | I | |
| | OFF | 2nd | .002<br>(.005) | | -.043<br>(.045) | .114<br>.136) | .05 |
| | | | | .019<br>(.010) | -.073<br>(.045) | .368<br>(.186) | .18 |
| | TAU | 3rd | .001<br>(.001) | | .003<br>(.020) | .009<br>(.050) | .11 |
| | | | | -.001<br>(.004) | .011<br>(.020) | -.062<br>(.080) | .08 |
| | OFF | 2nd | .002<br>(.005) | | -.043<br>(.045) | .114<br>(.136) | .05 |
| | | | | .019<br>(.010) | -.073<br>(.045) | .368<br>(.186) | .18 |
| | OFF | 3rd | .002<br>(.005) | | -.025<br>(.046) | .175<br>(.138) | .12 |
| | | | | .017<br>(.011) | -.053<br>(.046) | .413<br>(.192) | .21 |
| | TAU | 4th | .001<br>(.002) | | .004<br>(.021) | .009<br>(.063) | .04 |
| | | | | -.002<br>(.005) | .011<br>(.022) | -.065<br>(.092) | .04 |
| | OFF | 4th | .003<br>(.005) | | -.021<br>(.049) | .166<br>(.147) | .08 |
| | | | | .015<br>(.016) | -.042<br>(.050) | .349<br>(.208) | .13 |
| E76 | TAU and 1st OFF | | -.005<br>(.006) | | -.010<br>(.050) | .048<br>(.151) | .14 |
| | | | | .013<br>(.012) | -.050<br>(.052) | .368<br>(.219) | .15 |

TABLE 9 Continued

| Curricula Industry | TAU or OFF | Quarter | Coefficients and Standard Errors | | | | $R^2$'s |
|---|---|---|---|---|---|---|---|
| | | | $K_1$ | $K_4$ | V | I | |
| | TAU | 2nd | -.009<br>(.005) | | -.025<br>(.004) | .019<br>(.133) | .31 |
| | | | | .006<br>(.012) | -.063<br>(.050) | .306<br>(.208) | .22 |
| | OFF | 2nd | -.001<br>(.005) | | .012<br>(.044) | -.031<br>(.132) | .13 |
| | | | | .002<br>(.011) | -.009<br>(.048) | .125<br>(.199) | .06 |
| | TAU | 3rd | -.013<br>(.005) | | -.002<br>(.045) | -.223<br>(.137) | .27 |
| | | | | -.005<br>(.013) | -.032<br>(.055) | -.020<br>(.230) | .04 |
| | OFF | 3rd | -.003<br>(.005) | | -.005<br>(.042) | .013<br>(.127) | .06 |
| | | | | -.004<br>(.010) | -.023<br>(.045) | .146<br>(.187) | .05 |
| | TAU | 4th | -.006<br>(.005) | | -.067<br>(.045) | .034<br>(.135) | .26 |
| | | | | -.023<br>(.010) | -.039<br>(.044) | -.216<br>(.183) | .37 |
| | OFF | 4th | -.003<br>(.004) | | -.019<br>(.038) | .011<br>(.114) | .10 |
| | | | | -.003<br>(.009) | -.025<br>(.040) | .044<br>(.169) | .08 |
| E80 | TAU & OFF | 1st | -.016<br>(.011) | | -.006<br>(.005) | -.003<br>(.007) | .06 |
| | | | | -.009<br>(.006) | -.006<br>(.005) | -.005<br>(.008) | .07 |
| | TAU | 2nd | -.018<br>(.011) | | -.006<br>(.005) | -.005<br>(.007) | .06 |
| | | | | -.011<br>(.006) | -.006<br>(.005) | -.009<br>(.008) | .08 |

TABLE 9 Continued

| Curricula Industry | TAU or OFF | Quarter | Coefficients and Standard Errors | | | | R$^2$'s |
|---|---|---|---|---|---|---|---|
| | | | $K_1$ | $K_4$ | V | I | |
| | OFF | 2nd | -.018<br>(.011) | | -.004<br>(.005) | -.003<br>(.007) | .06 |
| | | | | -.010<br>(.006) | -.004<br>(.005) | -.006<br>(.008) | .06 |
| | TAU | 3rd | -.011<br>(.011) | | -.001<br>(.005) | -.003<br>(.007) | .02 |
| | | | | -.007<br>(.006) | -.001<br>(.005) | -.005<br>(.008) | .03 |
| | OFF | 3rd | -.009<br>(.010) | | -.001<br>(.004) | -.002<br>(.007) | .03 |
| | | | | -.006<br>(.005 | -.001<br>(.005) | -.004<br>(.007) | .03 |
| | TAU | 4th | -.005<br>(.011) | | -.003<br>(.005) | .006<br>(.007) | .05 |
| | | | | -.005<br>(.005) | -.003<br>(.005) | .003<br>(.007) | .06 |
| | OFF | 4th | -.009<br>(.011) | | -.002<br>(.005) | .003<br>(.007) | .04 |
| | | | | -.005<br>(.006) | -.002<br>(.005) | .001<br>(.007) | .05 |
| E87 | TAU and OFF | 1st | .004<br>.003) | | .006<br>(.004) | .003<br>(.010) | .08 |
| | | | | .001<br>(.003) | .005<br>(.005) | .001<br>(.010) | .03 |
| | TAU | 2nd | .004<br>(.003) | | .006<br>(.005) | -.005<br>(.011) | .07 |
| | | | | .002<br>(.003) | .005<br>(.005) | -.006<br>(.013) | .04 |
| | OFF | 2nd | .004<br>(.003) | | .007<br>(.005) | -.002<br>(.012) | .07 |
| | | | | .002<br>(.003) | .006<br>(.006) | -.002<br>(.014) | .03 |

TABLE 9 Continued

| Curricula Industry | TAU or OFF | Quarter | Coefficients and Standard Errors $K_1$ | $K_4$ | V | I | $R^2$'s |
|---|---|---|---|---|---|---|---|
| | TAU | 3rd | .005 | | .012 | .005 | .17 |
| | | | (.003) | | (.005) | (.010) | |
| | | | | .005 | .013 | .009 | .15 |
| | | | | (.003) | (.006) | (.014) | |
| | OFF | 3rd | .006 | | .012 | .006 | .16 |
| | | | (.003) | | (.005) | (.013) | |
| | | | | .006 | .012 | .011 | .13 |
| | | | | (.003) | (.006) | (.015) | |
| | TAU | 4th | -.002 | | .005 | -.011 | .04 |
| | | | (.003) | | (.006) | (.013) | |
| | | | | -.001 | .006 | -.011 | .04 |
| | | | | (.004) | (.006) | (.015) | |
| | OFF | 4th | .002 | | .012 | -.012 | .10 |
| | | | (.003) | | (.006) | (.015) | |
| | | | | .000 | .011 | -.005 | .09 |
| | | | | (.004) | (.006) | (.017) | |
| E88 | TAU and OFF | 1st | -.002 | | .028 | -.033 | .34 |
| | | | (.002) | | (.010) | (.029) | |
| | | | | -.002 | .028 | -.035 | .31 |
| | | | | (.004) | (.011) | (.040) | |
| | TAU | 2nd | .005 | | .018 | .053 | .35 |
| | | | (.003) | | (.012) | (.033) | |
| | | | | .010 | .019 | .098 | .37 |
| | | | | (.005) | (.018) | (.044) | |
| | OFF | 2nd | .002 | | .018 | .035 | .22 |
| | | | (.003) | | (.014) | (.040) | |
| | | | | .009 | .020 | .081 | .27 |
| | | | | (.005) | (.014) | (.053) | |
| | TAU | 3rd | -.000* | | .027 | -.001 | .34 |
| | | | (.003) | | (.001) | (.031) | |
| | | | | .004 | .028 | .029 | .36 |
| | | | | (.005) | (.011) | (.042) | |

TABLE 9 Continued

| Curricula Industry | TAU or OFF | Quarter | Coefficients and Standard Errors | | | | $R^2$'s |
|---|---|---|---|---|---|---|---|
| | | | $K_1$ | $K_4$ | V | I | |
| | OFF | 3rd | .002<br>(.003) | | .036<br>(.013) | .015<br>(.037) | .42 |
| | | | | .010<br>(.005) | .039<br>(.012) | .071<br>(.047) | .48 |
| | TAU | 4th | .002<br>(.002) | | .016<br>(.009) | -.010<br>(.023) | .16 |
| | | | | .001<br>(.004) | .015<br>(.009) | -.009<br>(.033) | .13 |
| | OFF | 4th | .001<br>(.003) | | .026<br>(.015) | .022<br>(.042) | .28 |
| | | | | .009<br>(.006) | .029<br>(.014) | .073<br>(.055) | .33 |

The results of the extension regressions were disappointing. As noted above, it was hoped that the extension regressions--dealing largely with night and short classes--would reflect differences in market structure better than the regressions for longer run (and often higher skilled) curricula. As can be seen in Table 9, no solid conclusions can be reached given the abysmally low $R^2$'s of the regressions, the lack of consistent findings, and the ephemeral statistical significance. If market forces have an influence here, it is a more subtle one than those which are captured by differences in concentration ratios, in relative industry size, and in absolute industry size during the previous Spring.

Because the extension regression results show no consistent or identifiable patterns and because they are so dissimilar to the V and T regression results, one can draw no useful conclusions or inferences concerning the influence of the "smaller" labor market which we assume exists for the recipients of extension type educational inputs. Perhaps the time lags are too long; perhaps the demand for such courses is provided largely by individual students or by particularly disadvantaged individual plants. Whatever the reason, the regression analysis does not capture any major effect.

The particularly poor "showing" of E87-Textile Production may be explained by the historic reticence of the largest industry in the state, textiles, to exhibit a collective interest in the training opportunities offered by the public authorities.

This attitude has recently changed. An article in the April 4, 1969 _News and Observer_ reads:

> "A major change in the State's future vocational educational program may have quietly begun Thursday."
>
> "North Carolina textile executives for the first time expressed strong interest and promised substantial support for development of a textile curriculum in the public schools and community colleges."
>
> "Charles H. Reynolds, vice president of Spindale Mills, appeared before the State Board of Education to urge that such a program be instituted in Rutherford County and indicated that he foresees a statewide need. 'Textiles, being one of the oldest industries in the world, ... perhaps has been a bit independent and perhaps we have been too proud to ask for assistance,' he said."
>
> "Education officials agree that lack of interest on the part of industry has prevented the development of more" /_ training programs _/
>
> "We have done our own training up to now" Reynolds said "and have done a reasonably good job until recently. Lately we just haven't had enough people to train. We need help, he added."
>
> "Representatives of Burlington Industries, Cone Mills, Fieldcrest Mills, Stonecutter Mills, and Virginia-Mastercraft are also lending support to Reynolds' proposal."[24]

As a relatively low wage industry and despite its predominance in a number of communities in the state (high V's), the textile industry has been under considerable wage pressure since the emergence of a tight labor market in 1965, and its share of state industrial employment has been shrinking.[25] The alteration in its approach to training is certainly consistent with the monopsony labor market hypothesis and with the results on V (as well, perhaps, as on $K_1$ and $K_4$) above.

---

[24] "Vocational Education Gets Textile Support," _News and Observer_, Raleigh, North Carolina, April 4, 1969.

## A Better Approach?

In an informal review of this report, Dr. Loren Ihnen, Associate Professor of Economics, N. C. State University, suggested that some of the apparent multicollinearity might be removed and the interpretation of coefficients made somewhat easier by omitting ratios from the regression. Ihnen notes that:

$$K_1 = \frac{N_1}{\sum_{i=1}^{n} N_i}$$

where i represents the various firms in the relevant curriculum industry and where firms are ranked in order of size,

$$K_4 = \frac{\sum_{i}^{4} N_i}{\sum_{i=1}^{n} N_i} \quad ,$$

$$V = \frac{\sum_{i=1}^{n} N_i}{\sum_{j=1}^{m} N_j}$$

where j represents all firms in the relevant labor market including the n firms in the relevant curriculum industry. Thus $m \geq n$, and

$$I = \sum_{i=1}^{n} Ni \quad .$$

---

[25] Donald D. Osburn, Negro Employment in the Textile Industries of North and South Carolina (Washington, D. C.; EEOC Research Report 1966-10, November 21, 1966).

Note that $\sum_{i=1}^{n} Ni$ appears in all four relationships in either the denominator or numerator. Ihnen suggests that the regressions be rerun with the following variables: $N_1$ or $\sum_{i=1}^{4} N_i$, $\sum_{i=1}^{n} N_i$, and $\sum_{j=1}^{m} N_j$. The preliminary nature of this examination and the statistical problems related to the dichotomous dependent variables argued convincingly against any rerun of the least square regressions at this time. If a form of probit analysis is used in subsequent work--as is suggested in Chapter III below, Ihnen's approach should be tried.

# CHAPTER III

# THE PROMISE OF "PROBIT" ANALYSIS[1]

Although it is useful (and natural for economists) to use classical least squares regression to identify the determinants of curriculum development and to estimate the effects of each independent variable, the dichotomous (1-0) nature of the dependent variable gives one (statistical) pause. As Goldberger notes, "the classical assumption of homoskedasticity is untenable" in such regressions for the disturbance term varies systematically with the values of the set of independent variables.[2] Although the coefficients obtained by classical least squares regression techniques are not obviously biased,[3] the predictive power of the model is questionable over any sizeable range of observations or experience. Note that in an unrestricted least squares model, the estimated value of the dependent variable (Y) may fall outside the 1-0 interval; a situation inconsistent with the definition of the dependent variable and one which confuses the interpretation of the estimate of the dependent variable (Y) as a probability.

One solution to these difficulties is the use of "probit" analysis. "Probit" analysis involves the estimation of critical values (U's) via maximum likelinood techniques from the values of the various dependent variables (X's). Assuming a standard normal cumulative distribution of Y's, the model can be described as:

---

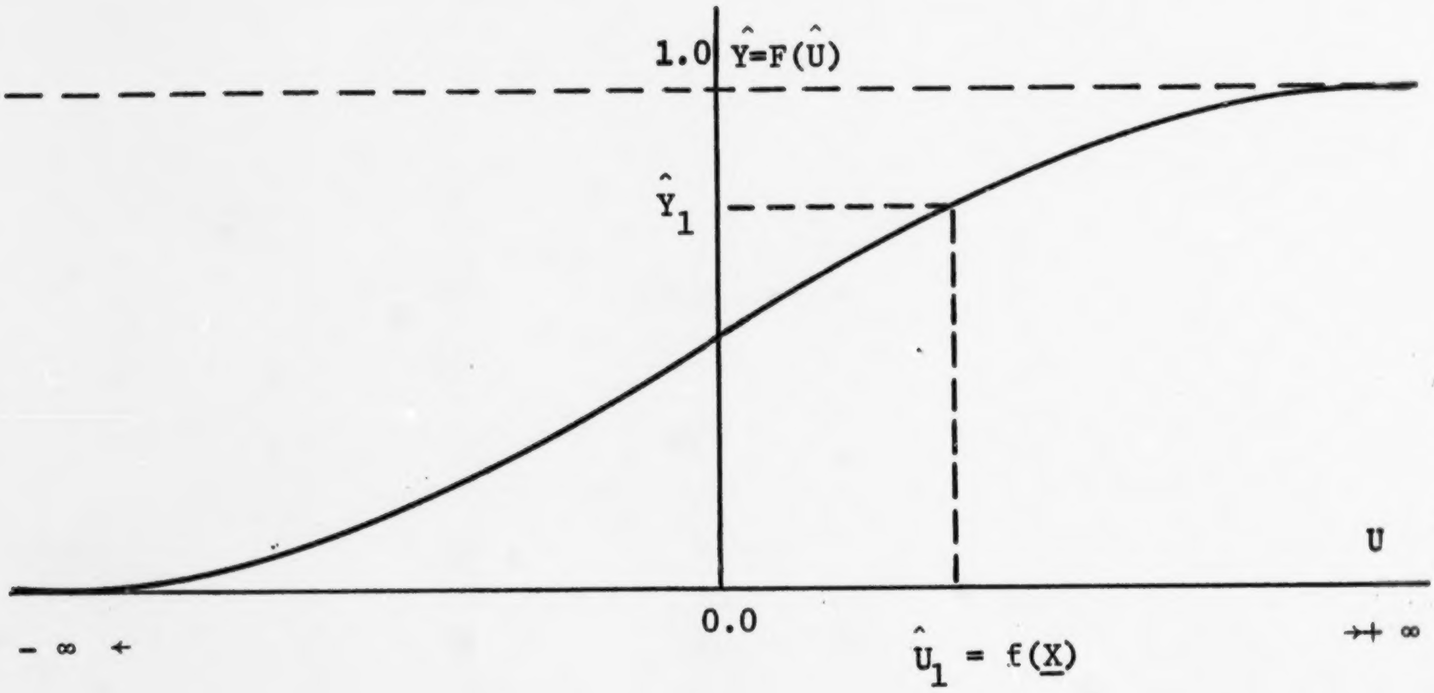
[1] As used here, the term "probit" analysis excludes the linear approximation adjustment which was commonly used before the widespread availability of computers. See D. J. Finney, Probit Analysis (Cambridge: Cambridge University Press, 1952), Especially Ch. 1-4 inclusive.

[2] Arthur S. Goldberger, Econometric Theory (New York: John Wiley & Sons, Inc., 1964), pp. 248-251.

[3] James Tobin, "Estimation of Relationships for Limited Dependent Variables," Econometrica, Vol. 26, (1958), pp. 24-36.
Richard N. Rossett, "A Statistical Model of Friction in Economics," Econometrica, Vol. 27, (1959), pp. 263-267.

$$\hat{Y}_t = F(\hat{U}_t) = f(X'_t\hat{B}).$$

Thus, one may "read off" the Y values from the standard normal cumulative distribution given the maximized U's. Graphically, we have the following:



Two experiments were conducted with the first quarter, V32 TAU's in a probit model. The results of these experiments were quite encouraging. In the first, U was maximized with respect to $K_1$, V, and I. In the second, $K_1$ was dropped, and the calculations converged more rapidly to the maximimum likelihood estimates. The first predictive equation was as follows:[4]

---

[4] I am indebted to Dr. Thomas Johnson for assistance on this portion of the paper and for the use of his computer routines. Dr. Johnson received his Ph.D. from NCSU in June, 1969, served as a Research Associate in Economics at NCSU during the summer, and joined the faculty at Southern Methodist University in the Fall of 1969.

$U = \alpha + \beta_1 K_1 + \beta_2 V + \beta_3 I + \varepsilon$

$\hat{U} = .0547 - .00274\, K_1 - .0155\, V + .0581\, I$

The second experiment, which ommitted $K_1$, yielded more satisfying results:

$U = \alpha + \beta_1 V + \beta_2 I + \varepsilon$

$\hat{U} = .746 - .0298\, V + .065\, I$

In the first experiment, the likelihood of the sample was -28.1556 and the hypothesis; $H_o: \beta_1 = \beta_2 = \beta_3 = 0$ was rejected at the .01 level. In the second experiment, the likelihood of the sample was -27.5029, a value even further removed from an equal probability L value of -34.6750 and easily significant at the .01 level with 3 degrees of freedom.[5]

---

[5] In the likelihood ratio tests, consider

$$\lambda = \frac{\underset{H_o}{\text{Max}}\, L(\underline{X}, \Theta)}{\underset{H_1}{\text{Max}}\, L(\underline{X}, \Theta)}$$

$- 2 \ln\lambda \sim \chi^2(n)$ where n = the number of restrictions.

$$\therefore -2 \ln\lambda = -2 \left[\ln \underset{H_o}{\text{Max}}\, L(\underline{X}, \Theta) - \ln \underset{H_1}{\text{Max}}\, L(\underline{X}, \Theta)\right]$$

Where $H_o: \beta_1 = \beta_2 = \beta_3 = 0$ & $H_1 = \beta_1, \beta_2, \beta_3 \neq 0$.

Now, $H_o \rightarrow$ an equal probability of occurance; i.e.,

$$\sum_{i=1}^{50} \ln P(W_1) = 50 \ln (.5) = -34.6750.$$

Finally, note that $\chi^2(3)_{.05} = 7.815$ and

$\chi^2(3)_{.01} = 11.341$

See Maurice G. Kendall and Alan Stuart, The Advanced Theory of Statistics (London: C. Griffin and Company Lmt., 1963), Vol. 2, p. 231.

Table 10 compares the observed value of Y with the two "probit" estimates. Note that the "probit" estimates still contain some obvious anomalies or large "misses"; for example, observations 35 and 49.

Nevertheless, one must regard the "probit" experimentation as a success from two standpoints. First, it is gratifying that the conclusions suggested by least squares analysis are not overturned by the more statistically satisfying "probit" approach. Second, the experiment seems to point the way toward a workable and statistically respectable method for developing an accurate predictive equation. Given the degrees of freedom available in any one quarter of the year and across the various years, numerous political, sociological, and economic variables could be introduced into the independent variable set. These might include indexes of local political power (Democratic or Republican, Committee positions in the State Legislature, etc.), preferences of local school administrators for vocational-technical as against academic curricula, special preference patterns for different geographic areas under particular national legislative arrangements (e.g.; the Coastal Plains or Appalachian programs), and the like. At a minimum, the "probit" approach promises to be a useful vehicle for intensive probing in this area of inquiry.

The arguments which might enter into a more comprehensive model are discussed in greater detail in Chapter IV.

## TABLE 10

### Comparison of Observed Value with Predicted Probability via "Probit" Techniques, V32, First Quarter 1967-68

| Observation Number | Observed Value Y | "Probit" | |
|---|---|---|---|
| | | $\hat{Y}_I$ | $\hat{Y}_{II}$ |
| 1 | 1.0 | .969 | .991 |
| 2 | 1.0 | .376 | .471 |
| 3 | 1.0 | .596 | .505 |
| 4 | 1.0 | .925 | .904 |
| 5 | 0.0 | .669 | .745 |
| 6 | 1.0 | .403 | .450 |
| 7 | 1.0 | .414 | .329 |
| 8 | 0.0 | .671 | .667 |
| 9 | 1.0 | .283 | .293 |
| 10 | 0.0 | .575 | .636 |
| 11 | 1.0 | .473 | .544 |
| 12 | 1.0 | .389 | .261 |
| 13 | 0.0 | .632 | .674 |
| 14 | 0.0 | .632 | .690 |
| 15 | 1.0 | .858 | .885 |
| 16 | 0.0 | .641 | .562 |
| 17 | 0.0 | .760 | .740 |
| 18 | 0.0 | .579 | .648 |
| 19 | 1.0 | .510 | .612 |
| 20 | 1.0 | .361 | .518 |
| 21 | 0.0 | .045 | .496 |
| 22 | 1.0 | .509 | .503 |
| 23 | 0.0 | .572 | .627 |
| 24 | 1.0 | .391 | .530 |
| 25 | 1.0 | .782 | .867 |
| 26 | 0.0 | .638 | .571 |
| 27 | 1.0 | .507 | .673 |
| 28 | 1.0 | .950 | .963 |
| 29 | 1.0 | .992 | .996 |
| 30 | 0.0 | .664 | .703 |
| 31 | 0.0 | .732 | .787 |
| 32 | 0.0 | .750 | .757 |
| 33 | 0.0 | .724 | .730 |
| 34 | 0.0 | .734 | .818 |
| 35 | 0.0 | .816 | .895 |
| 36 | 0.0 | .634 | .573 |
| 37 | 0.0 | .549 | .279 |
| 38 | 0.0 | .653 | .451 |
| 39 | 1.0 | .404 | .505 |
| 40 | 1.0 | .426 | .315 |

TABLE 10 - Continued

| Observation Number | Observed Value Y | "Probit" $\hat{Y}_I$ | $\hat{Y}_{II}$ |
|---|---|---|---|
| 41 | 1.0 | .394 | .373 |
| 42 | 0.0 | .712 | .691 |
| 43 | 0.0 | .640 | .597 |
| 44 | 1.0 | .885 | .864 |
| 45 | 0.0 | .726 | .730 |
| 46 | 0.0 | .697 | .671 |
| 47 | 1.0 | .663 | .600 |
| 48 | 1.0 | .750 | .781 |
| 49 | 1.0 | .379 | .455 |
| 50 | 0.0 | .650 | .804 |

# CHAPTER IV
# INTERNAL PRESSURES AND MANAGERIAL INCENTIVES

Chapter II, which concentrated on the labor market demand aspects of curriculum establishment, left much to be examined by other influences. Among these are:

1. Student demand,
2. State-wide or system-wide plans,
3. Local political and financial support,
4. Incentives implicit in existing budgetary or accounting procedures,
5. Cost levels for the various curricula, and
6. Tastes and preferences of administrators

At any given moment of time, the president or manager of a community college or technical institute has a choice among the prospective curricula upon which to expend his necessarily limited resources. To some degree, his choice is limited by physical facilities, but the physical limitations are not expected to influence most prespective course offerings. Thus, in fixing the curriculum mix, the educational manager may be influenced by any or all of the six factors listed above together with the labor market pressures discussed in Chapter II. Indeed, as suggested above, $\beta_{E.I}$ and even $\beta_{E.V}$ may reflect in part the plans promulgated by higher level political or educational administrators to the degree that these plans require justification of new curricular offerings on the basis of an existing local "user" group. We can, however, investigate the possible influence of implicit incentives on the curriculum mix; an investigation which of necessity also involves some consideration of (1) cost levels by curricula and (2) the tastes and preferences of individuals. It is to this task that we now turn.

## Theoretical Framework

Economic theory suggests that administrative mechanisms can create sets of internal incentives within a particular administrative structure and that these incentives will tend to move the system in a predictable direction--ceteris paribus. Obviously, among the factors held in ceteris paribus are the utility functions of the various managers of the educational institutions. To develop the simple structure of the model, let us assume that each institution is allocated R operating funds for time period t, where $R_t$ is a positive function of the number of full-time equivalent students in the previous period. Thus,

(1) $R_{t+1} = \alpha S_t$ where $\alpha > o$ and where $S_t$ = the number of full-time equivalent students in period t.

If one assumes that managers wish to maximize their compensation (in prestige and/or dollar form) and that this compensation tends to be positively correlated with $R_t$, the allocational mechanism implies a success criterion for managers given their tastes for curricula of various kinds.[1] Assume, further, that the institution has two possible curricula (vocational - "V" and academic - "A"), where the average variable cost per full-time equivalent student in V is greater than that in A. Thus,

(2) $\left(\frac{c}{s}\right)_V > \left(\frac{c}{s}\right)_A$ where $c_V$ and $c_A$ are the total variable costs of the respective programs.

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[1] Where managerial salaries are tied directly to FTE's, the salary system assures a positive correlation. Given the step-function character of most salary systems, the correlation may not be perfect.

These costs together with $R_t$ fix the total number of students who can be taught at each institution and the mix of these students. Assuming that

$$\left(\frac{c}{s}\right)_V = 1.2 \left(\frac{c}{s}\right)_A,$$ then we can write:

$$(3) \left(\frac{c}{s}\right)_V S_V + \left(\frac{c}{s}\right)_A S_A = R_t \text{ and}$$

$$(4) \left(\frac{c}{s}\right)_A (1.2\ S_v + S_A) = R_t$$

Since $R_{t+1} = \alpha S_t = S_V + S_A$, the incentive to convert the entire program to an academic one is obvious. Since $R_{t+1}$ will be maximized where $S_t$ is maximized, and

$$(5) \quad S_{A_t} = \frac{R_t}{\left(\frac{c}{s}\right)_A} > S_{V_t} = \frac{R_t}{\left(\frac{c}{s}\right)_V} = \frac{R_t}{1.2\left(\frac{c}{s}\right)_A}$$

the simple model leads to a corner solution in the direction of the "academic" program. Thus, given constant costs for the production of academic and vocational students, a manager who chose an entirely academic curriculum in period 1 could produce either more vocational or more academic students in period 2 than could the manager who chose an entirely vocational curriculum or any mixed curriculum during period 1. In period 2, however, given the incentive system, the manager would face a similar incentive to emphasize the low cost program since $R_{t+2}$ is a function of the curriculum mix in $R_{t+1}$. Note, in particular, that the incentive exists to move to the low variable cost curriculum without *regard to the rate of social or private return* in either curriculum.[2]

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[2] More rigorously, we assume that the manager seeks to maximize $R_{t+1}$ subject to the budgetary constraint. Forming the conventional LaGrangian multiplier, we have:

$$(7)\quad \frac{\partial}{\partial S_i}\left[R_{t+1} + \lambda\left(\left(\frac{c}{s}\right)_V S_V + \left(\frac{c}{s}\right)_A S_A - R_t\right)\right]$$

where i represents either A or V

$$(8)\quad \frac{\partial}{\partial S_i}\left[\alpha S_t + \lambda\left(1.2\left(\frac{c}{s}\right)_A S_V + \left(\frac{c}{s}\right)_A S_A - R_t\right)\right]$$

$$(9)\quad \frac{\partial S_t}{\partial S_V} = \frac{-\lambda}{\alpha}\, 1.2\left(\frac{c}{s}\right)_A$$

$$(10)\quad \frac{\partial S_t}{\partial S_A} = -\frac{\lambda}{\alpha}\left(\frac{c}{s}\right)_A$$

Now, at equilibrium, the gain in "effective" $S_t$'s or in $R_{t+1}$ must be equal for the two curricula if both are to exist simultaneously; i.e.,

$$(11)\quad \frac{\partial S_t}{\partial S_V} = \frac{\partial S_t}{\partial S_A}$$

But

$$(12)\quad \frac{-\lambda}{\alpha}\, 1.2\left(\frac{c}{s}\right)_A < \frac{-\lambda}{\alpha}\left(\frac{c}{s}\right)_A \text{; i.e., } \frac{\partial S_t}{\partial S_V} < \frac{\partial S_t}{\partial S_A}$$

Thus, $S_t$ and $R_{t+1}$ are maximized by specializing in $S_A$.

Institute managers, however, may not be totally free to alter or select their curriculum mix at any time. Indeed, curricula which are "on the books" may not be easily eliminated or new ones instantaneously established. For example, while maintaining the assumptions concerning relative costs, we may specify that $S_{V_t} = .25\ S_{A_t}$ in period 1 and that $\left| S_{V_{t+1}} \right| \geq \left| S_{V_t} \right|$. Maximization of $R_{t+1}$ under these conditions requires that $\left| S_{V_{t+1}} \right| = \left| S_{V_t} \right|$ with the entire growth in the program occuring among the $S_A$'s.

Note that educational planning authorities may have had a preference for the original mix of programs--$.25\ S_A = S_V$. The relatively declining share of $S_V$ in the total student numbers dramatizes a conflict between the institute manager and the planning authorities (say--the State Board of Education). It is important to recognize at this stage of the argument that the conflict does not have its origin in the perverseness or the preferences of the State or of the institute managers. Rather, its origin is in the incentives implied by a centrally administered allocation system, which incentives may be (and, in this case, are) contradictory in their behavior implications to the desires of the same central planners.[2]

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[2] Such bureaucratic conflicts and unintended results of allocational systems are very familiar to students of socialist decision making; including scholars who have examined the Soviet Union. See, for example, Joseph S. Berliner, "Managerial Incentives and Decision Making: A Comparison of the United States and the Soviet Union," The Soviet Economy, A Book of Readings, edited by M. Bornstein and D. R. Fusfeld (Homewood, Illinois: Richard D. Irvin, Inc., 1966), pp. 109-140; Robert M. Fearn, "Controls over Wage Funds and Inflationary Pressures in the USSR," Industrial and Labor Relations Review, Vol. 18, No. 2 (January 1965), pp. 186-195; Robert W. Campbell, Soviet Economic Power (Boston: Houghton Mifflin Co., 1966), Second Edition, Chapters 3-5 incl.; and George Stigler, The Intellectual and the Market Place, and Other Essays (London: Collier-MacMillan Ltd., 1963), Chapter 1.

The simple introductory models above assume constant average variable costs in each curriculum. Let's assume for the moment that each curriculum is characterized by the familiar U-shaped cost curve. Under such conditions, the same motivations would lead the various institute managers to operate each curriculum near the minimum average variable cost point and, if possible, to shift students to those sets of academic, technical or vocational curricula with the lowest minimum average variable cost points so as to maximize student numbers. Indeed, a naive accounting view of these administrative operations would show that such administrators were highly successful in "keeping costs down." They might even be lauded for their administrative prowess even when their cost consciousness (or more accurately, FTE consciousness) leads them to expand low rate of return educational programs at the expense of high return programs. Thus, "cost consciousness" under these conditons may impose very substantial opportunity losses on the society and on the students.

Finally, it seems appropriate to consider the likelihood that various institutions possess differing productive capabilities in V and A even with the same $R_t$'s. The analysis thus far has considered only one institution--implicitly assuming that we can characterize all institutions by identical educational possibility curves. Even within a narrowly confined geographic area of a state, there may be differential degrees of access among institutes to particularly inputs (say--the low cost availability of skilled teachers in metropolitan as against rural areas). Thus, the degree of response--but not the direction--may vary substantially among institutes. It also follows from the simple dynamics that the optimal mix of vocational and academic students in the various institute given their differences in resource availabilities may not result in the mix of students desired by the central planners. The section below on optimal curriculum mix, cost weighting and shadow prices considers this issue in more detail.

## Relevance of the Theoretical Model to the History of Occupational Education

The analysis above appears to be relevant to a controversy which has raged throughout the history of occupational education in the U.S. The controversy concerns the degree to which occupational and academic educational activities can co-exist in the same physical location or under the same administrative structure. The controversy has carried several labels--comprehensive versus specialized training, vocational needs and the "academic" administrator, the "proper role" of vocational training in secondary and post-secondary education, etc.[3]

Most discussions of this conflict have pointed to (1) the "academic mindedness" of educational administrators and (2) the disparity in prestige between academic and occupational training. The incentive analysis above suggests that the budgetary and allocation system *itself* may induce administrators to move in the direction of one program or another *without regard* to the personal preferences of the administrators or the relative levels of prestige attached for various programs. To call attention to the role of implicit incentives is not to insist that psychological and/or sociological factors play no role in the decision making process, but only to suggest that these noneconomic factors may be assisted or checked by the success criteria "built into" the allocational formulae.

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[3] See in particular: Gerald B. James, "The Emerging Role of State Departments of Education with Implications for Vocational Education," The Emerging Role of State Education Departments (Columbus, Ohio: Center for Vocational and Technical Education, Research Series No. 11, 1967), pp. 305-318; Morgan V. Lewis and Jacob J. Kaufman, "The Role of the Secondary Schools in the Preparation of Youth for Work," Journal of Industrial Teacher Education, IV, No. 3 (March 1966), pp. 4-11; Russel Clay, "N. C. Training Plan Criticized," The News and Observer, Raleigh, N. C., November 15, 1968; Committee on Education, Guidance, and Work, Reorganizing Secondary Education in New York City (New York: Public Education Association, October 1963); Carolyn Zimmerman, "UNC Professor Expresses Concern Over Evaluation of N. C.'s Institutes," The Star News, Wilmington, N. C., November 3, 1967.

## A North Carolina Test--Relevance of the Analysis to the North Carolina System of Community Colleges and Technical Institutes

### The North Carolina System

It is clear from the North Carolina *Policy Manual*[4] that the North Carolina allocation system is based largely upon full-time equivalents (FTE's) and that the salaries of local managers are also in part functions of the measures (See *Policy Manual* sections 3.0126 and 3.031). Specifically, the *Manual* provides that annual variable resource commitments be made largely on the basis of FTE's in the fall quarter of the year. Thus, $R_t = \alpha S_t$, $R_{t+1} = \alpha' S_t$, $R_{t+2} = \alpha'' S_t$, and $R_{t+3} = \alpha''' S_t$ where the time period is defined as a quarter year and $\alpha$, $\alpha'$, $\alpha''$, and $\alpha'''$ are factors in the formula budgeting system. Sections 4.0211 ff. also show that the initiative for establishment of new curricula and cancellation of old curricula rests largely with the institute manager (subject, of course, to review by state authorities and to certain legislative restrictions).

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[4] Department of Community Colleges, State Board of Education, State of North Carolina, *Policy Manual for the System of Community Colleges* (Raleigh, N. C.: Department of Community Colleges, 1969), Loose-leaf Manual as of March 10, 1969).

In North Carolina, a full-time equivalent is defined as:

> "..a student budgetary unit, weighted by programs, which represents the amount of time a 'typical' student would attend class. One full-time equivalent is calculated as a student enrollment of 16 hours of class, shop, or laboratory per week of 44 weeks, the full four quarter school year.[5]

Thus, North Carolina experience might reflect the operations of internal incentives if differences in average variable costs are substantial among curricula. What then can be said about the existence and relevance of cost data by curriculum; an admittedly difficult area?

Cost Data

Several research projects completed and/or currently underway have accumulated and/or analyzed cost data by curriculum. In a study of eight publicly supported junior and community colleges in three states and employing a rather common procedure for cost allocations, E. F. Anderson[6] found that within institutions, cost per student for engineering technologies, health and medical curricula, and industrial and technical studies consistently exceeded per student costs for the liberal arts and college parallel options. Moreover, cost per student in business and office occupational training was lower than per student costs in liberal arts and college parallel training.

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[5] I. E. Ready, N. C. Department of Community Colleges, Administrative Memorandum No. 1-2, July 16, 1968.

[6] E. F. Anderson, Differential Costs in Curricula in Comprehensive Junior Colleges (Urbana, Illinois: Bureau of Educational Research, University of Illinois, 1966), Monograph.

Parry,[7] using North Carolina data for 10 schools, found vocational and technical curricula to be more costly per membership hour than college parallel curricula. Some representative examples of Parry's cost estimates are contained in Table 11. Ihnen's review[8] of these studies points up the very substantial difficulties of allocating common costs as against separable costs. He also discusses which costs should be included in various cost-benefit calculations. As Ihnen points out, one may need to consider different sets of costs for different curriculum and planning decisions. Certainly, separable marginal costs are relevant to the adoption of new curricula whereas some elements of what might otherwise be considered as fixed costs would be relevant to the physical expansion of the institution. Note that Ihnen's analysis was addressed to a different set of questions than those considered here. Ihnen asked: What costs are relevant, in principle, to decisions concerning the establishment or disestablishment of particular curricula; presuming that the educational planners wished to maximize the social and/or private returns to their scare educational dollars? This paper is concerned

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[7] E. B. Parry, An Investigation of Cost Differentials between Trade, Technical, and College Parallel Curriculums (Raleigh, N. C., Department of Community Colleges, 1968).

[8] Loren A. Ihnen, "Vocational and Technical Education: Costs and Returns," Unpublished paper, Department of Economics, North Carolina State University, February 1969.

## Table 11

### Cost per Membership Hour for Various Curricular Programs at N.C. Community Colleges and Technical Institutes (Total State Current Expenditures)[a]

| Colleges & Institutes | 1965-66 | | | | 1966-67 | | | |
|---|---|---|---|---|---|---|---|---|
| | Liberal Arts A.A. Degree | Business Administration A.A.S. Degree | Electronics Technician A.A.S. Degree | Machinist Diploma | Liberal Arts A.A. Degree | Business Administration A.A.S. Degree | Electronics Technician A.A.S. Degree | Machinist Diploma |
| College of the Albermarle | $.887 | n.appl. | $2.980 | $1.381 | $1.014 | n.appl. | $1.603 | $1.188 |
| Asheville-Buncombe T.I. | n.appl. | .874 | .920 | .909 | n.appl. | .953 | 1.180 | 1.228 |
| Central Piedmont C.C. | .763 | .691 | 1.221 | 1.799 | .838 | .646 | 1.110 | 1.416 |
| Fayetteville T.I. | n.appl. | .860 | 1.020 | 1.239 | n.appl. | .978 | 1.035 | 1.232 |
| Forsyth T.I. | n.appl. | .807 | 1.140 | 1.893 | n.appl. | .888 | 1.072 | 1.507 |
| Gaston C.C. | .980 | n.appl. | 1.055 | .903 | 1.185 | n.appl. | 1.138 | 1.022 |
| Pitt T.I. | n.appl. | n.appl. | 1.289 | 1.829 | n.appl. | .760 | 1.176 | 1.702 |
| Rowan T.I. | n.appl. | n.appl. | 1.373 | 2.404 | n.appl. | 1.059 | 1.287 | 1.497 |
| Southeastern C.C. | 1.207 | 1.401 | n.appl. | n.appl. | 1.404 | 1.489 | n.appl. | 2.328 |
| Alamance | n.appl. | .706 | 1.250 | 1.613 | n.appl. | .691 | 1.235 | 1.526 |

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[a] Ernest Bruce Parry, Research and Devlopment Study of State Funding and Business Management Procedures in Community Colleges and Technical Institutes in the State of North Carolina, Unpublished doctor's dissertation, Vol. 1, (Chapel Hill, N.C., The University of North Carolina, 1968), Tables XI-XX incl.

with the fact that perceived differences in average variable costs per student or per student hour among programs will generate a particular program mix; given the allocational formula.

Although relatively little cost data are available, that which is available suggests a particular "pecking order" in costs per student contact or membership hour. Thus, in the absence of other considerations, one would expect the North Carolina system to contain an implicit incentive toward the low variable cost programs; usually those with high student-teacher ratios. Such an incentive would operate both between academic, technical, and vocational curricula and within various categories of curricula.

In North Carolina, the incentive for curriculum drift can occur only to the degree that cost per student hour differs among curricula. The formula for calculation of FTE's compensates for the difference in the number of contact hours per semester in the three major curricula. Under the North Carolina system, each student who spends either 30 hours per week in a vocational curriculum, 24 hours per week in a technical curriculum, or 16 hours per week in an academic curriculum for 44 weeks is counted as 30/16, 24/16, or 16/16 FTE's respectively. Alternatively stated, the FTE formula implicitly assumes cost weights of 1.875 for vocational students, 1.5 for technical students, and 1.0 for academic students. It follows from the analysis above that incentives will be created in one direction or another to the degree that these implicit cost weights do not conform to the perceived average variable costs of the different programs.

Historic Experience

The following data, obtained from the records of the Department of Community Colleges, indicate that the number of curricular offerings and the number of enrolled students have moved in the direction one would have predicted from the analysis above and from student costs; particularly costs per membership (contact) hour calculated by Parry and to a smaller degree, the costs per student hour seen by Anderson. These cost data, despite some problems with allocation of overhead expenses, suggest that costs per student and student contact hour for business and office occupational training are less than costs of academic training and costs of vocational and technical training. Moreover, these data suggest that the per student and the per student contact hour cost in academic curricula are less than such costs in vocational and technical curricula. Thus, to the degree that internal incentives are conditioning the curriculum mix, one would expect business and office occupational training to be instituted or "pushed" more aggressively than both the general academic programs and the vocational and technical programs in the community college system. Similarly, academic programs in the community colleges should grow at the expense (relatively) of technical and vocational programs. Moreover, a similar difference in emphasis over time should appear between (1) business and office occupations and (2) vocational and engineering technology programs within the technical institutes.

The available data on curriculum composition in North Carolina community colleges and technical institutes is consistent with this interpretation. Table 12, showing the growth in the proportion of curricular programs from 1965-66 through 1967-68 in average annual FTE's, indicates a relative shift in the direction of the lower cost college

### Table 12

### Relative Size of Curricular Programs[a] - North Carolina Department of Community Colleges, 1965-66 through 1967-68 (Average Annual FTE)

| | 1965-66 | 1966-67 | 1967-68 |
|---|---|---|---|
| College Parallel | 14.7 | 19.7 | 22.0 |
| Technical | 41.4 | 42.3 | 43.1 |
| Vocational | 43.9 | 38.0 | 34.9 |
| | 100.0% | 100.0% | 100.0% |
| Total FTE | 10,320 | 13,846 | 18,166 |

[a] Source: State Board of Education, Department of Community Colleges, Annual Enrollment Report, Full-Time Equivalents, 1965-66 and 1966-67 and 1967-68 (Raleigh, N. C.; State Board of Education, October 1966, November 1967, and November 1968).

parallel programs relative to the technical programs. Vocational programs actually declined in their proportion of the total. A similar pattern is seen in Table 13, which presents the relative shares of the various regular budget programs. Only when the large number of special budgetary programs are included in the total do the vocational programs increase relatively over time, as seen in Table 14. The relative growth in vocational programs results, however, from a sharp absolute decline in training for new industry, in MDTA programs, and in adult basic education programs--all of which are supported largely by special state and national funds.

Analysis of the various curricular offerings by quarters shows business administration, secretarial and college parallel programs growing more rapidly than "all technical programs" and much more rapidly than the high variable cost programs in engineering technology. Full-time equivalents in selected curricular programs by quarters, 1966-67 through the winter quarter, 1968-69, are presented in Table 15. In order to simplify comparisons of growth rates, Table 16 presents the rank order of increase in the various curricular programs over various periods of time. Note the general consistency of the rankings in inverse order to the expected costs per student hour. Table 17 presents the actual percent increases over various time periods--highlighting the "curriculum drift" toward low average variable cost programs most strikingly.

Although the data in Tables 12 through 17 are consistent with the internal incentives hypothesis, they certainly do not "prove" that the observed changes in curriculum mix resulted from the operations of the internal incentive system. These data, however, are consistent with that hypothesis.

Table 13

Relative Size of Regular Budget Programs -
North Carolina Department of Community Colleges,
1965-66 through 1967-68[a]
(Annual Average FTE)

| | 1965-66 | 1966-67 | 1967-68 |
|---|---|---|---|
| College Parallel | 9.2 | 13.0 | 14.5 |
| Technical | 26.1 | 27.9 | 28.3 |
| Vocational | 27.6 | 25.1 | 22.9 |
| Occupational Extension | 31.2 | 15.8 | 15.0 |
| Adult High School | | 5.4 | 5.2 |
| General Adult Extension | | 9.9 | 9.8 |
| Learning Laboratory | 5.9 | 3.8 | 4.3 |
| | 100.0% | 100.0% | 100.0% |
| Total FTE | 16,401 | 20,949 | 27,629 |

[a] Source: See Table 12 above.

Table 14

Relative Size of All Program Groups -
North Carolina Department of Community Colleges[a]
(Annual Average FTE)

| Program | 1965-66 | 1966-67 | 1967-68 |
|---|---|---|---|
| College Parallel | 5.9 | 9.7 | 12.2 |
| Technical | 16.6 | 20.7 | 23.8 |
| Vocational | 17.6 | 18.6 | 19.3 |
| Occupational Extension | 19.9 | 11.7 | 12.7 |
| Adult High School |  | 4.0 | 4.4 |
| General Adult Extension |  | 6.7 | 8.3 |
| Learning Laboratory | 3.8 | 2.8 | 3.6 |
| Adult Basic Education | 13.7[b] | 10.4 | 7.5 |
| Manpower Develop. and Training Act | 8.2 | 7.4 | 5.5 |
| New Industry | 13.9 | 7.0 | 1.4 |
| Self-Supporting | 0.4 | 1.0 | 1.3 |
|  | 100.0% | 100.0% | 100.0% |
| Total FTE | 25,704 | 28,250 | 32,747 |

[a] Source: See Table 12 above.

[b] Economic Opportunity Act Program.

Table 15

Full-Time Equivalents; Selected Programs by Quarters, Fall 1966-67 - Winter 1968-69[a]

| Programs | Winter 1968-69 | Fall 1968-69 | Summer 1967-68 | Spring 1967-68 | Winter 1967-68 | Fall 1967-68 | Summer 1966-67 | Spring 1966-67 | Winter 1966-67 | Fall 1966-67 |
|---|---|---|---|---|---|---|---|---|---|---|
| All College Parallel | 5356 | 6690 | 2656 | 4440 | 4220 | 5262 | 1566 | 2869 | 2223 | 3477 |
| including Pre-Business | 686 | 1043 | 329 | 739 | 582 | 784 | 187 | 328 | 315 | 526 |
| All Technical Programs | 12477 | 14572 | 3476 | 9008 | 10132 | 12112 | 2443 | 7107 | 7614 | 9131 |
| including | | | | | | | | | | |
| Office Occupations | 6422 | 7631 | 1611 | 4548 | 5102 | 6164 | 1082 | 3550 | 3812 | 4589 |
| Business Administration | 2809 | 3286 | 625 | 1946 | 2174 | 2522 | 409 | 1377 | 1403 | 1693 |
| Secretarial | 2304 | 3787 | 586 | 1671 | 1906 | 2367 | 428 | 1365 | 1506 | 1733 |
| Engineering Technology | 3377 | 4075 | 1013 | 2663 | 3061 | 3615 | 722 | 2197 | 2421 | 3057 |
| All Vocational Programs | 8443 | 9598 | 2592 | 6406 | 6883 | 7449 | 4482 | 5463 | 5664 | 6105 |
| Total Curricular Programs[b] | 26276 | 30860 | 7723 | 19854 | 21235 | 24823 | 8491 | 15439 | 15501 | 18713 |

[a] N. C. State Board of Education, Department of Community Colleges, Curriculum Registration Reports, Summer 1966-67 through Winter 1968-69, and computer printout in the files of the Department of Community Colleges, Fall 1966-67 through Spring 1966-67.

[b] Parts may not sum to total due to rounding.

## Table 16

### Rank Order of Increase of Selected Curricular Programs for Various Time Periods, 1966-1969[a]

| Programs | Fall 1968-69 / Fall 1966-67 | Fall 1968-69 / Fall 1967-68 | Winter 1968-69 / Winter 1966-67 | Winter 1968-69 / Winter 1967-68 | Spring 1967-68 / Spring 1966-67 | Summer 1967-68 / Summer 1966-67 |
|---|---|---|---|---|---|---|
| Pre-Business | 2 | 2 | 2 | 5 | 1 | 1 |
| Business Administration | 4 | 3 | 3 | 1 | 3 | 3 |
| Secretarial | 1 | 1 | 4 | 4 | 4 | 5 |
| All College Parallel | 3 | 5 | 1 | 2 | 2 | 2 |
| Engineering Technology | 6 | 6 | 6 | 6 | 5 | 4 |
| Vocational | 5 | 4 | 5 | 3 | 6 | 6 |

[a] Source: See Table 19.

Table 17

Percent Increase in Full-time Equivalents; Selected Programs for Various Time Periods, 1966-1969[a]

| Programs | Fall 1968-69 / Fall 1966-67 | Fall 1968-69 / Fall 1967-68 | Winter 1968-69 / Winter 1966-67 | Winter 1968-69 / Winter 1967-68 | Spring 1967-68 / Spring 1966-67 | Summer 1967-68 / Summer 1966-67 |
|---|---|---|---|---|---|---|
| All College Parallel Programs | 92.4 | 27.1 | 140.9 | 26.9 | 54.8 | 69.6 |
| including Pre-Business | 98.3 | 33.0 | 117.8 | 17.9 | 115.3 | 75.9 |
| All Technical Programs | 59.6 | 20.3 | 63.9 | 23.1 | 26.7 | 42.3 |
| including |  |  |  |  |  |  |
| Office Occupations | 66.3 | 23.8 | 68.5 | 25.9 | 28.1 | 48.9 |
| Business | 94.3 | 30.3 | 100.2 | 29.2 | 41.3 | 52.8 |
| Secretarial | 118.5 | 60.0 | 53.0 | 20.9 | 22.4 | 36.9 |
| Engineering Technologies | 33.3 | 12.7 | 39.5 | 10.3 | 21.2 | 40.3 |
| All Vocational Programs | 57.2 | 23.8 | 49.1 | 22.7 | 17.3 | ---[b] |
| Total Curriculum Programs | 64.9 | 24.3 | 69.5 | 23.7 | 28.6 | ---[c] |

[a] Source: See Table 15 above.

[b] Reduction to 58.0 percent of base level.

[c] Reduction to 91.0 percent of base level.

Other evidence provides additional support. The two year versus one year comparisons suggest that the longer the time period, the stronger the drift to low variable cost programs. Moreover, because fall enrollments are crucial in the North Carolina allocational system, differential growth rates among programs in the fall quarter as compared to other quarters may reflect greater effort in offering and filling low variable cost programs in the fall compared to other quarters. Looking at the two year comparisons, one finds the variation in the growth in the various mutually exclusive curricula from fall to fall to be somewhat larger than the coefficients from winter to winter. In particular, the deviation of the highest cost and lowest cost programs from the average curricular growth rate seems to be less pronounced in the winter to winter comparison:

| | $\frac{\text{Fall 1968-69}}{\text{Fall 1966-67}}$ | $\frac{\text{Winter 1968-69}}{\text{Winter 1966-67}}$ |
|---|---|---|
| Pre-Business | .515 | .695 |
| Business Administration | .453 | .014 |
| Secretarial | .541 | .442 |
| Engineering Technology | -.487 | -.238 |
| Vocational | -.119 | -.432 |
| Average $\lvert d \rvert$ | .425 | .364 |

The one year comparisons show a similar reduction in the growth spread of the various curricula from the fall to the winter quarter, but an apparent reversal of pattern in the spring quarter. The rates are as follows:

| | Fall 1967-68 / Fall 1966-67 | Winter 1967-68 / Winter 1966-67 | Spring 1967-68 / Spring 1966-67 |
|---|---|---|---|
| Pre-Business | .358 | -.264 | 3.031 |
| Business Administration | .247 | .202 | .444 |
| Secretarial | .469 | .140 | -.217 |
| Engineering Technology | -.478 | -.577 | -.259 |
| Vocational | .185 | -.066 | -.296 |
| Average $\|d\|$ | .347 | .250 | .849 w/Pre-business<br>.304 w/o Pre-business |

## Caveats

Further research is needed to "firm up" the influence of internal incentives on curriculum mix as compared with the influence of "tastes" (administrator's preferences for particular programs), the influence of local advantages (say--the easy availability of instructors for particular programs), and the influence of student "demand." One possible approach to isolating the influence of "tastes" would employ multiple regression analysis to explain changes in curriculum mix among institutions over various time periods. Dependent variables might be defined as the proportion of high (or low) variable cost programs or high, medium and/or low cost programs. Independent variables might include (1) a qualitative variable denoting the background of the chief administrative officer as a proxy for his "academic mindedness," and (2) the industrial characteristics of the area served by each institution--a proxy for the relative availability of skilled instructors for high cost programs. In this formulation, the intercept term would "pick up" the curriculum drift associated with the internal incentives and/or with student demand.

A formulation such as that suggested here should provide greater insight into the influence of taste factors and special factor availabilities in the determination of curricular mix. Because "taste" factors are discussed above, one needs at the juncture only to consider factor availabilities. It is clear from theory that factor availabilities may also be important determinants of curriculum mix. Indeed in a recent study, Ihnen and Carroll found some indication that differences in the nature of the community and local factor availabilities influenced the supply price of particular kinds of occupational education teachers.[9] These differences might be reflected in curricular offerings.[10]

Returning to the model described above, one might easily ascribe the intercept term, $\alpha$, to factors other than internal incentives. The most likely alternative explanatory variable would be "student demand." The "drift" which we observe could represent a shift in curricular offerings or emphasis designed to meet increased or persistent student demands for those curricula which also happen to be low-variable cost curricula. Unfortunately, at our present stage of knowledge, there is no clear way to determine precisely what one means when one uses the term "student demand." Some measure of student desire might be had if students ranked their occupational training preferences prior to being exposed to the various curricular offerings, but after being exposed to the nature, compensation, conditions, and training requirements for various occupations.

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[9] A. B. Carroll and Loren Ihnen, A Study of Supply and Demand for High School Vocational Teachers in Three Southeastern States (Unpublished monograph, Center for Occupational Education, NCSU, 1968). The existence of local supplements for particular programs also complicates the analysis.

[10] A more complete discussion of the difficulties introduced into administrative central systems by differing factor availabilities is contained in the next section.

Alternatively, one could construct a general model seeking to explain curricular offerings via probit analysis solely from the supply side--using variables such as internal incentives, labor market pressures, administrative tastes, statewide plans, and local political and financial support.[11] Student "demand" might then be seen as determining the degree to which these new curricular offerings are viable--via measures of student enrollment, curriculum transfers subsequent to initial enrollment, etc. The host of interpretation problems are obvious, but the investigation might prove very useful for policy makers; given the truncated nature of demand in the educational industry and the presence of internal incentives.

## Cost Weighting - A Solution to Curriculum Drift?

The analysis to this point has been concerned with the potential for curriculum drift and with the existence of such a drift in North Carolina. Note that the drift may be toward or away from that curriculum mix which would be socially or privately optimal as judged by the equality of the rates of return for the various curricula.[12] It is also of interest to note that the "drift" induced by the incentives implicit in the allocational formula may be checked by revising the allocational formula to include variable cost weighting for the various curricula. Using the simple model developed above and under the allocation rule:

---

[11] Note again that within a system all managers face the same internal incentives and the same state plans except to the degree that factor availabilities and costs differ or are thought to differ among institutes.

$$(13) \quad R_{t+1} = \alpha S_t \quad ,$$

one might require that $S_t$ be "cost weighted" as in (14).

$$(14) \quad S_t = S_V \left[ \frac{\left(\frac{c}{s}\right)_V}{\left(\frac{c}{s}\right)_A} \right] + S_A \ .$$

This formulation eliminates the implicit bias in the direction of $S_A$ seen in the simple model above.[13]

---

[12] This analysis assumes that education acquired in community colleges and technical institutes represents largely an investment in future income streams, both privately and socially, as compared with education as a current consumption good. The broad issue of the applicability of rate of return analysis to various forms of education is discussed in Theordore W. Schultz, "The Rate of Return in Allocating Investment Resources to Education," The Journal of Human Resources, Vol. II, No. 3 (Summer, 1967), pp. 293-309.

[13] Thus, in the simple model above, we have:

$$(15) \quad \frac{\partial}{\partial S_V} \left[\alpha S_t + \lambda \left(1.2 \left(\frac{c}{s}\right)_A S_V + \frac{c}{s_A} S_A - R_t\right)\right] = \frac{\partial}{\partial S_V} \quad (Z)$$

$$(16) \quad \frac{\partial S_t}{\partial S_A} = -\frac{\lambda}{\alpha} \left(\frac{c}{s}\right)_A 1.2 \text{ and } (17) \quad \frac{\partial S_t}{\partial S_A} = -\frac{\lambda}{\alpha} \left(\frac{c}{s}\right)_A = \frac{\partial}{\partial S_A} \quad (Z)$$

Thus, in principle, curriculum drift resulting from internal incentives can be checked or eliminated by appropriate cost weighting

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Now:

$$\frac{\partial S_t}{\partial S_A} = \frac{1}{\partial S_A} \left[ S_V \frac{\left(\frac{c}{s}\right)_V}{\left(\frac{c}{s}\right)_A} + S_A \right] = 1 \text{ and}$$

$$\frac{\partial S_t}{\partial S_V} = \frac{1}{\partial S_V} \left[ S_V \left( \frac{\left(\frac{c}{s}\right)_V}{\left(\frac{c}{s}\right)_A} \right) + S_A \right] = \frac{\left(\frac{c}{s}\right)_V}{\left(\frac{c}{s}\right)_A}$$

Thus $\frac{\partial}{\partial S_V} (Z) = \frac{\partial}{\partial S_A} (Z)$ since:

$$(18) \quad 1 = -\frac{\lambda}{a} \left(\frac{c}{s}\right)_A = -\frac{\lambda}{a} \left(\frac{c}{s}\right)_A 1.2 \left[ \frac{\left(\frac{c}{s}\right)_A}{\left(\frac{c}{s}\right)_V} \right] \quad \text{where}$$

$$\left[ \frac{\left(\frac{c}{s}\right)_A}{\left(\frac{c}{s}\right)_V} \right] = \frac{1}{1.2}$$

in the allocational formula. Note that, the FTE calculations employed by the State of North Carolina can be interpreted as an attempt to avoid curriculum drift resulting from differences in cost per student which result from a larger number of instructional hours per week required for vocational and technical students relative to college parallel students. Indeed, to the degree that the ratios of 1.875, 1.5 and 1.0 are appropriate to the vocational, technical and college parallel curricula respectively, the N. C. system implies equal costs per student contact (membership) hour. Parry's data, however, suggest that these hour related cost weights still do not compensate entirely for the implicit "drift" in the system.[14]

In attempting to conceptualize and/or fully implement a cost weighting policy, a number of complications arise. First, as noted above, one faces a substantial problem in obtaining the cost data upon which to calculate the magnitude and direction of the implicit incentives and with which to "correct" the drift. In a recent unpublished article, Ihnen devotes considerable attention to the practical problems of data collection in this area, to the problem of allocating common costs, and to the problem of selecting the appropriate cost measure for the evaluation of particular curricular decisions.[15] Obviously, at the current state of development, data problems abound.

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[14] E. B. Parry, op. cit.

[15] Ihnen, loc. cit.

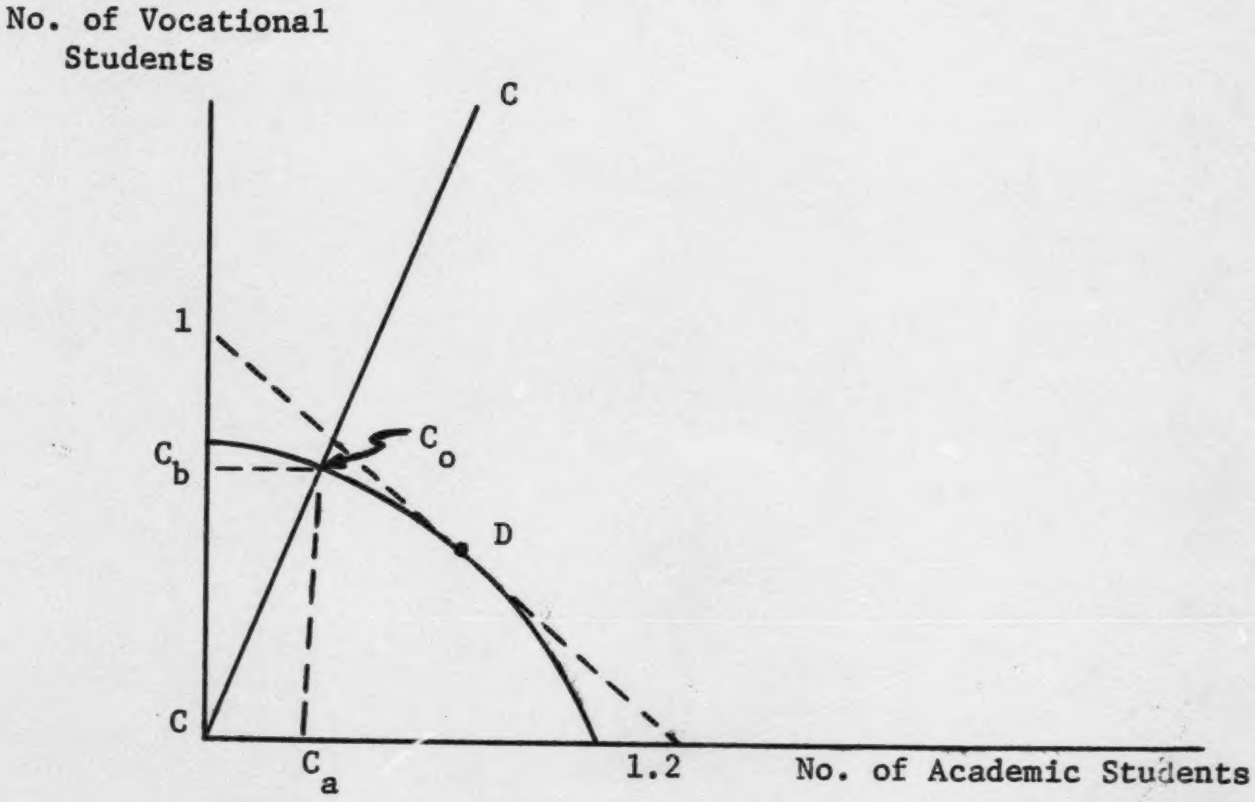
A second complication concerns the shape of the average variable costs curve per student (or student hour) with the output of students. Assume, for example, that average variable costs per student (or student hour) are U-shaped in all curricula. Under such conditions, the same incentives implicit in a non-cost-weighted formula will lead the various managers to operate near the minimum average variable cost point for each curriculum and, if possible, to shift students to those sets of curricula with the absolutely lowest minimum average variable costs so as to maximize student numbers.

Generalizing the control problem, one may assume that the educational production possibility curve is curvilinear, as in Chart 2. If one also assumes that the output mix desired by the educational planners is $C_b$ / $C_a$ and that the trade-off implicit in the allocational formula is 1/1.2, the educational planners will have to alter the formulas such that the "shadow price" or the cost weight will be equal to the slope of the tangent to the possibility curve at $C_o$.

In this regard, it is important to remember that the desired mix-CC above - may not be socially optimal in the sense that the social rate of return to V is equated to the social rate of return to A, including the valuation of all externalities to the respective curricula. Given CC, however, cost weighting will help to reduce the slippage between

# Hypothesized
# Educational Production Possibility
# Curve and Curriculum Draft

Chart 2


No. of Vocational Students
C
1
$C_b$
$C_o$
D
C
$C_a$
1.2
No. of Academic Students

levels of management -- whether slippage is toward or away from social optimality. What cost weighting does -- given the fact that the desires of purchasers of educational services may have little weight in fixing the curriculum - is clearly to place the onus for errors in curriculum mix upon the central managers of the system. Thus, if particular programs "turn out" to exhibit low rates of return, responsibility for the creation and continuance of such program rests solely with the central planners.[16]

In discussing the complications of administrative control, it is useful to return briefly to an earlier consideration -- that of the academic-or-vocational "mindedness" of school administrators, one might well ask "How do the cost weights work if local decision makers have strong predilections for one or the other set of programs?"

Assuming that the cost weights are "correct" in the sense that they would lead an unbiased administrator-one without personal preferences for one or the other curriculum-to adjust his mix to the socially desired one, the cost weighting scheme would penalize those administrators who deviated from the desired mix in any direction. Thus, the administrator who deviates from the planned mix to exercise his personal prejudices will pay the cost of those prejudices. The penalty will be in terms of future (and perhaps present) allocations of resources. Moreover, if administrative salaries are linked to the cost weighted FTE measures, each administrator will have a clear incentive to comply with the socially planned output mix. Thus, the system over time will tend to be self-enforcing against deviations due to personal predilections. Note that this will be true even when those predilections are in the direction of real social optimality.

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[16] As noted above, following T. W. Schultz, I have assumed here that social optimality can be judged by internal social rates of return. There is a considerable literature on the practical and theoretical difficulties of such a stance. See Heishliefer, *op. cit.*, T.W. Schultz, *op. cit.*, and the entire symposium on rates of return in education published in the Vol. II, No. 3 (Summer 1967), *Journal of Human Resources*.

Even where feasible, however, cost weighting is not a "total" solution to the many problems of administrative control. It is a commonplace that humans are remarkably (and in a sense delightfully) proficient in avoiding regulatory devices.[17] Quite obviously, there are a number of ways in which school administrators can avoid the regulations. For example, if the cost weights are based upon experience at each school, then inflation or deflation of these costs by the administration in any one period may have a payoff in a desired direction in the next period. What one can hope for by the system of analysis and control suggested here is that the analysis will permit one, first, to identify the unintentional drift of the system, second, to reduce this drift, and third, to fix responsibility for curriculum development and errors rather than having responsibility diffused through a myraid of administrative levels and offices.

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[17] There is a vast literature on the problems of decision making, administrative direction, and economic rationality under socialism. The following brief list will suffice to introduce the subject, but no brief list can provide a well rounded view into the wealth of insight (and the attendant policy problems) in this area. See in particular George N. Halm, Economic Systems, A Comparative Analysis (New York: Holt, Rinehart and Winston, Inc., 1967). Third Edition, particularly Part 4 ff.; Oskar Lange and Fred M. Taylor, On the Economic Theory of Socialism (Minneapolis, the University of Minnesota Press, 1938); Milton Friedman, Capitalism and Freedom (Chicago: The University of Chicago Press, 1962) and A. C. Pigou, Socialism versus Capitalism (London: MacMillan and Company, Ltd., 1964).

One final complication is worth exploring. The problem revolves around the differing capacities of the various institutes to perform in the various instructional areas; that is, the degree to which the long run real costs of inputs are dissimilar among institutes. Aside from the few comments above on factor availabilities, the analysis thus far has assumed that all educational institutions have access to similar variable cost input factors such that we could characterize them by identical educational possibility curves. Even within a narrowly confined geographic area like a state, this assumption may not be true in any short run period. Some of Parry's results suggest that this may have been true in North Carolina in 1965-67.[18] Indeed, to the degree that there are differential degrees of access among institutes to particular inputs (say - local subsidies tied to particular programs or the availabilities of skilled teachers in metropolitan compared to rural areas for reasons outside the community college system), then the assumption of identical or nearly identical possibility curves breaks down.

To illustrate the complications this introduces into the planning and directing process, one may assume two institutes (or two sets of institutes) with differing "production" capabilities. These are illustrated as DE and DF in Chart 3. If the planning authorities assume that all educational institutions have identical production frontiers DE and fix PP in order to produce a CC' curriculum mix, one institute will comply while the other will produce CC"; "too much" V and relatively (and absolutely) less A. In order to produce CC", the shadow price facing both institutions will need to be raised for V and lowered for A, moving both institutes in the direction of relatively more A and so that the average output of the two institutes equals CC'. Thus, the DE institute

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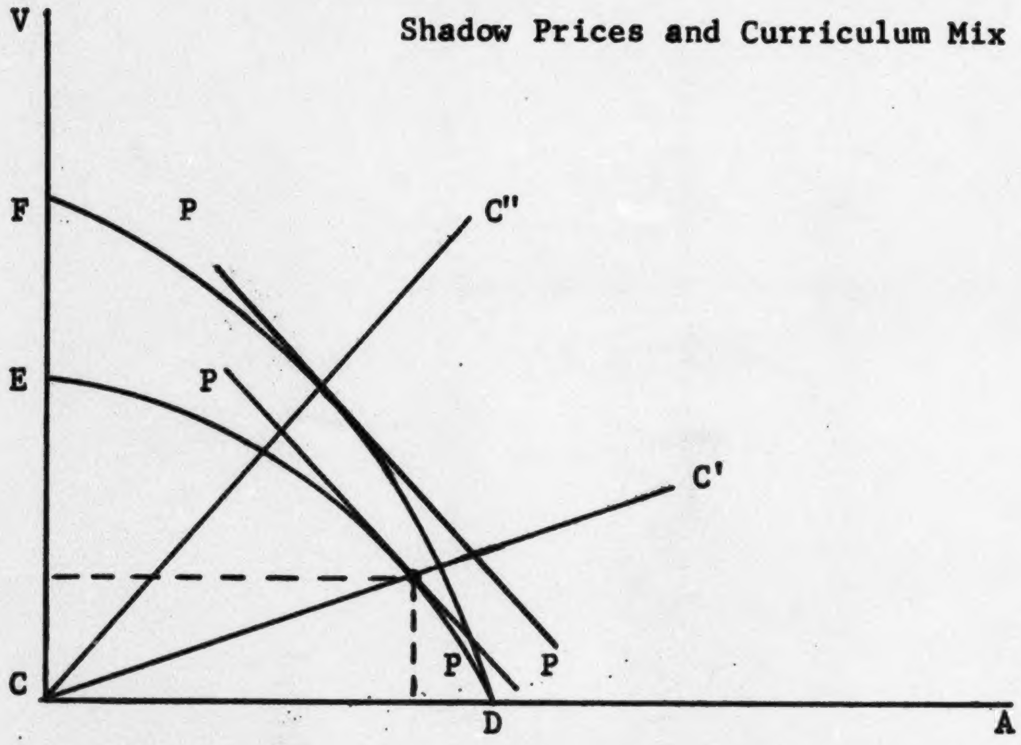
[18] E. B. Parry, op. cit.

Chart 3

Shadow Prices and Curriculum Mix



specializes relatively more in A - the "output" in which it possesses a comparative advantage. Most of the "V" output then is produced by the DF institute, which possess a comparative advantage in the production of V. Note that unless the required price line gives a corner solution at E for DE, both institutes continue to "produce" V's and A's in each time period. "Fine tuning" of the system would, therefore, require detailed knowledge about differences in real costs among institutes - an impossible requirement at our present stage of knowledge. Alternatively, the planning authorities could experiment with various shadow prices (or costs) until the desired educational output mix is forthcoming from the system. For more details on the techniques of "market socialism," see Lange and Taylor, loc. cit. [19]

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[19] This paper would be deficient if it left the impression that most or all of the major issues of educational planning had been considered here. Indeed, this analysis has abstracted from one very important area of analysis--the set of fundamental questions concerning public versus private operation (and financing) of the school system. For example, the "voucher" system suggested by Milton Friedman might be even more applicable to 13th and 14th grade level than to primary and secondary schools; provided that prospective students and their families are well aware of private rates of return to the various curricula and that "externalities" of the various curricula are few. The crucial issues in this debate are discussed in detail in M. Friedman, Capitalism and Freedom (Chicago: The University of Chicago Press, 1962), Chapter VI and in Henry M. Levin, The Failure of the Public Schools and the Free Market Remedy (Washington, D. C.: The Brookings Institution, 1968); a Brookings reprint (148) which originally appeared in The Urban Review, Vol. 2, No. 7 (June 1968), pp. 32-37.

## Chapter V
## SUMMARY AND CONCLUSIONS

Available empirical evidence concerning the demand for particular curricula at North Carolina community colleges and technical institutes is consistent with the two hypotheses developed and examined in this study. These hypotheses are:

1. that labor market structures--particularly labor market monopsony--can be expected to influence curricular offerings at public institutions, and
2. that budgetary allocation procedures within the educational system can be expected to create internal monetary incentives which condition and perhaps determine present and future curricular offerings.

With respect to hypothesis #1, various least squares regression results indicate that within local labor market areas the existence or nonexistence of relevant curricular offerings will be positively related to the absolute size of the "using" industry and negatively related to the relative size of the "using" industry. The latter effect is consistent with a theoretical formulation by Becker, Mincer, and Reder; a formulation which implies that plants buying labor competitively will be unable to recover the costs of broadly-based training programs, and, therefore, will restrict employer-financed training programs to skills which are plant (or firm) specific. Moreover, the latter effect is consistent with the existence of monopsony cartels in the various local labor market areas.

The regressions do not usually indicate a statistically significant negative relationship between the existence of various curricula and the extent of employer concentration in either the largest one or the largest four plants in the local area. Because the concentration ratios among the various labor market areas in North Carolina are generally quite high and because tacit or overt coordination of wage and employment policy might be expected under these conditions, the "monopsony effect" will depend largely upon the availability of alternative employment opportunities in the local labor market areas; an effect which would be picked up by the relative size of the using industry in total employment. This conclusion follows only if the local labor markets are characterized by high cross elasticities of supply among skill groupings and industries--an assumption which is not too "unrealistic." Finally, this interpretation is consistent with the April 1969 request from the associated textile manufacturers to the Department of Community Colleges for training assistance; training which is intended to alleviate the effect of growing alternative employment opportunities under the generally tight labor market conditions now existing throughout the Carolinas.

Given continued industrialization of the South and continued high levels of aggregate demand, one might expect new curriculum requests in North Carolina and throughout the South to be associated with growing alternative employment opportunities at high skill levels within each local labor market area.

Because of particular statistical inadequacies, one may rely upon the signs of the observed regression coefficients (i.e., the direction of the effects), but not on the magnitudes of these coefficients. The method of least squares assumes homoskedasticity of residual variances--an assumption which is clearly violated in regressions such as the ones above in which the dependent variable is dichotomous. In order to make further progress in this area, a more suitable statistical technique must be employed. Preliminary experimentation with multiple variable "probit" analysis suggests that it may be the appropriate statistical tool.

With respect to hypothesis #2, the available data from the N. C. Department of Community Colleges are consistent with the hypothesis that educational systems tend to move toward that curriculum mix which is most "profitable" for the local unit administrator or administrators. In North Carolina, where the various programs apparently differ in variable costs per student and per student contact hour and where the budgetary system formulae use full-time equivalents as the base for determining allocations of funds for operating expenses, the entire system is moving in the direction predicted by the theoretical model--toward the low average variable cost curricula. This "curriculum drift" applies both to major program areas--college parallel, technical, and vocational--and to the curriculum mix within major programs. Moreover, the movement apparently is taking place without reference to the differential benefits of the various programs. Alternative explanations of the drift including student demand, local supplements and the "tastes" of administrators are briefly examined. It is conceivable that the observed curriculum drift has resulted from these forces and not from "internal incentives." Tests of these propositions are discussed in considerable detail.

Finally, this study elaborates a rudimentary system of administrative control designed to contain "curriculum drift." The main outlines of the system--employing variable cost weights--are presented in the text. If and when adequate social rate of return data by curriculum are available, cost weighting control devices could be used to direct educational programs toward social optimality--the maximization of social returns given alternative social costs. Until that time, cost weighting controls could at least prevent unintentional "curriculum drift."

# OCCUPATIONAL EDUCATION DEMAND QUESTIONNAIRE

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Raleigh, North Carolina

1968

# Appendix A

# DEMAND QUESTIONNAIRE AND COVERING LETTER

## INSTRUCTIONS

The attached questionnaire is an important part of a study being conducted by the Center for Occupational Education on the demand for occupational training. As you are well aware, additional understanding of the components of demand will help to anticipate construction and curricular needs and to provide more adequately for the various groups of demanders. We would appreciate your cooperation in completing the questionnaire and returning it to us in the enclosed self-addressed envelope.

The demand for new curricular offerings comes from many quarters. For the purposes of this study, we are interested not only in the direction from which these demands come, but also in the relative intensity of the various demands at the time each curriculum was initiated. We, therefore, ask you to rank the various demanders according to the intensity of their demands on a 1-to-5 scale, with "1" representing the most intense and "5" representing the least intensive demand. It is likely that a curriculum may have been demanded by only one or two of the five demanders. If so, leave the others blank. Some examples are provided below.

Some curricula may have been initiated without a clear indication of demand from any particular group. These are cases in which the college, institute, or unit administrators felt that a strong demand was nascent in the community and would become visible after the establishment of the curriculum, and cases in which the skill provided might be of use to a much broader "community" than the local county or multi-county area. An example of the latter case is the sanitary engineering curriculum at Fayetteville. In these instances, please leave column 1 through column 5 blank, checking column 6 instead.

The five "demanders" in columns 1 through 5 are defined as follows:

1. Existing local employers--industrialists, businessmen, governmental units, etc.

2. "New" or prospective employers-perhaps those participating in a "package" arrangement sponsored by the State Department of Conservation and Development.

3. Existing or prospective students.

4. Superior administrative bodies such as the Department of Community Colleges in Raleigh. Please specify..

5. Others. Please specify.

In each of these cases, a clear indication of demand should have been available to the administrator. This is of particular importance with respect to #3. Where students, actual or potential, had been requesting curricula of particular types, #3 should be given its appropriate ranking. Where the administrator believed that student demand would emerge with the institution of the curricula, #6 should be checked.

The attached sheet gives several hypothetical examples. Note that T01 was instituted after experiencing a strong demand from new or prospective employers together with demand of somewhat lesser magnitude from existing employers. T02 was initiated independently without a clear indication of desire from any particular group. T03 was established after experiencing a strong demand from prospective students together with pressures from the Department of Community Colleges in Raleigh and with a tertiary demand from existing employers. T04 was instituted after a strong desire for additional skilled persons was evidenced by the local trade union council. A somewhat smaller demand was experienced from existing employers.

In the event that the establishment of the curricular offerings preceded your administration, please consult any persons or school records necessary to obtain the desired information.

Finally, if curricula have been terminated, please note the date of termination, use the same rating scale (1-to-5) to designate the relative lack of demand for the course, and provide a brief explanation as in the examples below.

### EXAMPLE

### Demand Rating Scale for College Parallel, Technical, and Vocational Curricula at Northsouthern Technical Institute

(Do not include occupational extension or adult education curricula)

| Curriculum Code Number | Quarter Initiated (or Terminated) | Initial Demanders | | | | | (6) Independently Initiated |
|---|---|---|---|---|---|---|---|
| | | (1) Existing Employers | (2) "New" or Prospective Employers | (3) Students | (4) Superior Educational Authorities | (5) Others | |
| C01 | | | | | | | |
| " | | | | | | | |
| " | | | | | | | |
| " | | | | | | | |
| T01 | Fall, 1961 | 2 | 1 | | | 3<br>(Municipal Officials) | |
| T02 | Fall, 1961 | | | | | | ✓ |
| T03 | Spring, 1962 | 3 | | 1 | 2<br>(DCC) | | |
| T04 | Spring, 1962 | 2 | | | | 1<br>(Trade Union Council) | |
| T05 | Fall, 1962 | 2 | 1 | 3 | 4<br>(DCC) | 5<br>(Statewide Trade Association) | |
| T05 | Terminated Spring, 1963 | | 1<br>(Relocation plans discontinued) | | | 2<br>(Extreme difficulties in recruiting instructors) | |
| T06 | | | | | | | |
| V01 | | | | | | | |
| " | | | | | | | |

## Demand Rating Scale for College
## Parallel, Technical, and Vocational Curricula at

____________________________________________

(Do not include occupational extension or adult education curricula)

| Curriculum Code Number | Quarter Initiated (or Terminated) | Initial Demanders | | | | | (6) |
|---|---|---|---|---|---|---|---|
| | | (1) Existing Employers | (2) "New" or Prospective Employers | (3) Students | (4) Superior Educational Authorities | (5) Others | Independently Initiated |
| | | | | | | | |

# Appendix B

## CORRELATION MATRIXES FOR SELECTED CURRICULUM-INDUSTRIES, 1967-68

## Appendix Table B-1

## Correlation Matrixes

### T-45

Electronics, Annual Data, 1967-68
County --

| $K_1$ | $K_4$ | V | NP | P | I | E |
|---|---|---|---|---|---|---|
| 1.000 | .833 | -.126 | .166 | -.670 | -.795 | -.406 |
| | 1.000 | -.150 | .163 | -.819 | -.890 | -.338 |
| | | 1.000 | .325 | -.306 | .431 | -.327 |
| | | | 1.000 | -.198 | -.109 | -.020 |
| | | | | 1.000 | .557 | .457 |
| | | | | | 1.000 | .290 |
| | | | | | | 1.000 |

ABE --

| $K_1$ | $K_4$ | V | NP | P | I | E |
|---|---|---|---|---|---|---|
| 1.000 | .769 | -.291 | .023 | -.674 | -.746 | -.519 |
| | 1.000 | -.270 | .009 | -.691 | -.898 | -.346 |
| | | 1.000 | .335 | -.245 | .557 | -.134 |
| | | | 1.000 | -.136 | .055 | .026 |
| | | | | 1.000 | .484 | .571 |
| | | | | | 1.000 | .308 |
| | | | | | | 1.000 |

# Correlation Matrix
## T-75

Furniture, Annual Data, 1967-68

County --

| $K_1$ | $K_4$ | V | NP | P | I | E |
|---|---|---|---|---|---|---|
| 1.000 | .755 | -.563 | .164 | -.220 | -.683 | -.450 |
| | 1.000 | -.654 | .216 | -.277 | -.950 | -.716 |
| | | 1.000 | .244 | -.324 | .769 | .566 |
| | | | 1.000 | -.289 | -.101 | .046 |
| | | | | 1.000 | .114 | .179 |
| | | | | | 1.000 | .817 |
| | | | | | | 1.000 |

ABE --

| $K_1$ | $K_4$ | V | NP | P | I | E |
|---|---|---|---|---|---|---|
| 1.000 | .674 | -.485 | .269 | -.258 | -.612 | -.398 |
| | 1.000 | -.723 | .131 | -.228 | -.935 | -.726 |
| | | 1.000 | .277 | -.295 | .741 | .528 |
| | | | 1.000 | -.361 | -.103 | -.032 |
| | | | | 1.000 | .149 | .214 |
| | | | | | 1.000 | .825 |
| | | | | | | 1.000 |

# Correlation Matrix
## T-37

Chemicals, Annual Data 1967-68
County --

| $K_1$ | $K_4$ | V | NP | P | I | E |
|---|---|---|---|---|---|---|
| 1.000 | .649 | .424 | .219 | -.519 | -.409 | -.193 |
| | 1.000 | .190 | .225 | -.673 | -.886 | -.484 |
| | | 1.000 | .274 | -.379 | .075 | -.167 |
| | | | 1.000 | -.621 | -.327 | .091 |
| | | | | 1.000 | -.679 | .270 |
| | | | | | 1.000 | .387 |
| | | | | | | 1.000 |

ABE --

| $K_1$ | $K_4$ | V | NP | P | I | E |
|---|---|---|---|---|---|---|
| 1.000 | .631 | .506 | .078 | -.337 | -.445 | -.422 |
| | 1.000 | .164 | .286 | -.583 | -.835 | -.439 |
| | | 1.000 | .367 | -.378 | .030 | -.123 |
| | | | 1.000 | -.580 | -.183 | .091 |
| | | | | 1.000 | .591 | .367 |
| | | | | | 1.000 | .538 |
| | | | | | | 1.000 |

## Correlation Matrix
## T-50

Manufacturing, Annual Data, 1967-68
County --

| $K_1$ | $K_4$ | V | NP | P | I | E |
|---|---|---|---|---|---|---|
| 1.000 | .910 | -.419 | .525 | -.505 | -.614 | -.366 |
|  | 1.000 | -.375 | .529 | -.578 | -.698 | -.424 |
|  |  | 1.000 | -.345 | -.235 | .286 | -.373 |
|  |  |  | 1.000 | -.381 | -.578 | -.373 |
|  |  |  |  | 1.000 | .775 | .489 |
|  |  |  |  |  | 1.000 | .546 |
|  |  |  |  |  |  | 1.000 |

ABE --

| $K_1$ | $K_4$ | V | NP | P | I | E |
|---|---|---|---|---|---|---|
| 1.000 | .934 | -.371 | .540 | -.509 | -.607 | -.326 |
|  | 1.000 | -.359 | .577 | -.599 | -.703 | -.420 |
|  |  | 1.000 | -.436 | -.156 | .301 | .167 |
|  |  |  | 1.000 | -.354 | -.520 | -.248 |
|  |  |  |  | 1.000 | .768 | .508 |
|  |  |  |  |  | 1.000 | .597 |
|  |  |  |  |  |  | 1.000 |

## Correlation Matrix
## V-32

Manufacturing, Annual Data 1967-68
County --

| $K_1$ | $K_4$ | V | NP | P | I | E |
|---|---|---|---|---|---|---|
| 1.000 | .934 | -.371 | .540 | -.509 | -.607 | -.454 |
| | 1.000 | -.359 | .577 | -.599 | -.703 | -.468 |
| | | 1.000 | -.436 | -.156 | .301 | -.083 |
| | | | 1.000 | -.354 | -.520 | -.177 |
| | | | | 1.000 | .768 | .528 |
| | | | | | 1.000 | .486 |
| | | | | | | 1.000 |

ABE --

| $K_1$ | $K_4$ | V | NP | P | I | E |
|---|---|---|---|---|---|---|
| 1.000 | .910 | -.419 | .525 | .505 | -.614 | -.466 |
| | 1.000 | -.375 | .529 | -.578 | -.698 | -.513 |
| | | 1.000 | -.345 | -.235 | .286 | -.100 |
| | | | 1.000 | -.381 | -.578 | -.321 |
| | | | | 1.000 | .775 | .496 |
| | | | | | 1.000 | .448 |
| | | | | | | 1.000 |